COLOR ORGAN FOR HOME CONSTRUCTION

RADIO & TV NEWS

OCTOBER
1957
35 CENTS

World's Leading Electronics Magazine

Including
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ELECTRONICS ON THE HURRICANE SHIP

CHOOSING YOUR HI-FI CROSSOVERS

TRACKING EXTERNALLY CAUSED HUM

TWO-METER AMPLIFIER

SERVICING YOUR OWN SIGNAL GENERATOR

SERVICING MOBILE COMMUNICATIONS EQUIPMENT

(See Pages 73 & 75)

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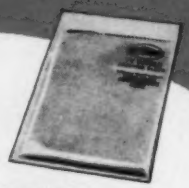
TRUCK DECAL



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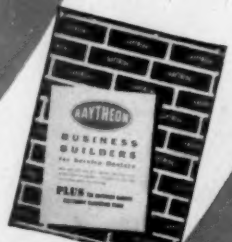

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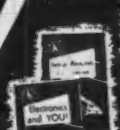

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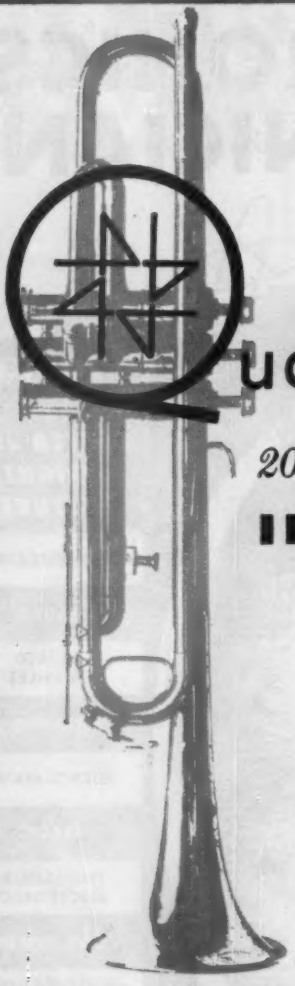

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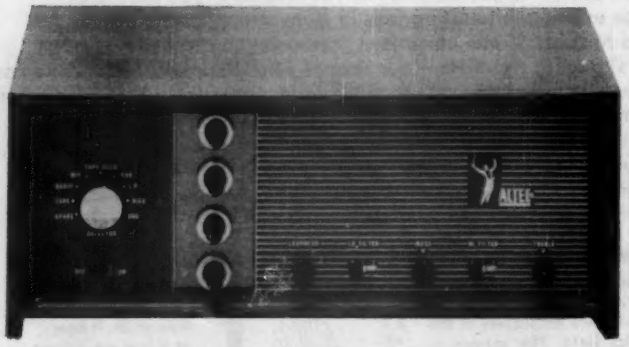

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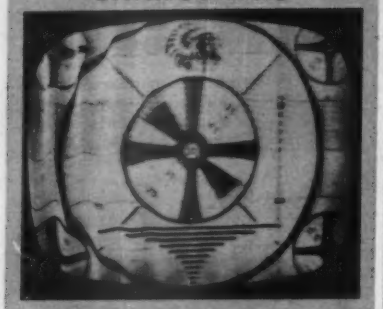

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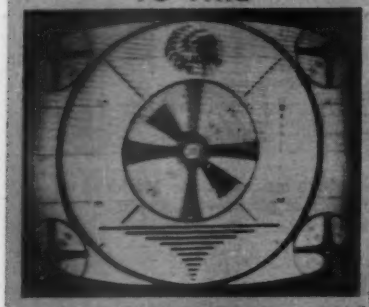

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738068 D-43	[illegible]	NW-1	738066 [illegible]-118X
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For the RECORD

THE REPLACEMENT POTENTIAL

WHILE transistorized portable radios have been around just about long enough to capture the public's fancy, some reports have already reached our ears concerning difficulties in getting replacements for components that have gone bad in such sets. Specialization of transformers and other parts and super-miniaturization of such "standard" components as speakers, electrolytic capacitors, and even resistors have led to a frustrating situation when a new part is needed.

The service technician goes to the independent jobber with whom he is accustomed to dealing. The latter throws up his hands, since he does not have the item. The next approach is made directly to the manufacturer or to his nearest local facility. How available this source is may depend on how big the manufacturer is or how close to a metropolitan center the customer and service outlet are located. Sooner or later, the needed component is obtained and the receiver is restored to operation, leaving in its wake three unhappy people: the local wholesaler who lost the sale because he couldn't supply the part, the service technician who had to submit to the badgering of the impatient customer, and the customer who was deprived of the use of his equipment during the wait.

If the long-term reliability of transistorized equipment lives up to its early promise, the business of getting replacement parts may never become more serious than it already is. Nevertheless, we see coming to the fore once more a problem that the industry has carried on its back for as long as anyone can remember, whether the assembled product before the public is a simple radio, a TV receiver, a transistorized portable, or whatever other electronic products the future may bring.

In the TV era, for example, procurement of a replacement yoke, flyback, or dual control, compatible with its chassis both electrically and physically, continues to be a problem after more than 10 years. If the variety and quantity of electronic equipment for the home increases over the years to the extent that the industry claims it will, then the replacement problem will grow with it.

What stands in the way of universal availability of replacement parts? Lack of standardization is often blamed, but we will never have that as long as experimentation and new ways of doing things continue. Equipment manufacturers feel that they are doing their share as long as they make replacements available through their own distribution channels.

As for manufacturers of components, they have done a good job in many ways. Nevertheless, the feeling persists that the continuing difficulty in getting replacements, irrespective of the type of equipment involved, exists because this segment of the industry has been lax in supplying its distributors.

In recent years, many new firms have entered the component field and have prospered. Many of these have established themselves primarily on the basis of making available full lines of replacement components that may be relied upon to be direct substitutions. Much ingenuity has been shown in this direction in devising single units that will legitimately replace several others found in original equipment. These newcomers owe their very success to the fact that old-line manufacturers have fallen short in handling the problem.

Why did they miss the boat when less established operators found the answer? The difficulty is that the business in replacement parts has always had to take a back seat to the meatier business of selling parts, in large quantities, to the manufacturer of the original equipment. As long as profit is a dominant motive, it is understandable that the component producer places such emphasis on going after the "thousand-at-a-time" sales instead of the tougher "single-sale" business.

However, would it be foolish for a parts manufacturer to take time out now to pursue the relatively less profitable traffic in replacements for, say, transistorized circuits? We may find an answer in the history of TV. Without great fanfare, we have passed into the era where Americans are spending more money annually—estimates run to over $2 billion—to keep their TV receivers in repair than they are spending to buy new sets. In other words, the volume in replacements is coming to be the dominant factor in the TV component business, and the process continues. This same pattern is bound to repeat itself irrespective of the particular type of electronic equipment that is before the public at any given period. A little altruism now in relieving the replacement problem, with respect to transistorized portables or anything else, can be a shrewd investment in the future. The foresighted and aggressive manufacturer won't overlook any possibilities in this field. . . . . W. S.

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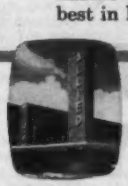

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HOW THE CLUB OPERATES: To enjoy these great savings—mail the coupon, indicating which one of the four Club Divisions best suits your musical taste: Classical; Jazz; Listening and Dancing; Broadway, Movies, Television and Musical Comedies.

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Your only obligation is to purchase four selections from the more than 100 that will be offered during the next 12 months. The records you want are mailed and billed to you at only $3.98 (original cast Musical Shows somewhat higher), plus a small mailing charge.

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Each month you will send me the Columbia (LP) Record Club Magazine which describes the records offered in all four Club Divisions. I have the privilege of accepting the monthly selection in the Division checked above, or any other selection described, or none at all. My only obligation is to purchase four records in the next 12 months at the regular list price plus a small mailing charge. After accepting four records, I will receive a free Bonus record for every two additional records I purchase. If not delighted with membership, I may cancel within 10 days by returning all records.

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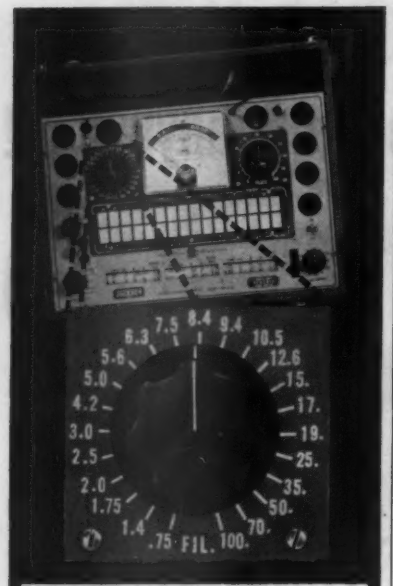
2. **The Voice** Frank Sinatra in 12 songs that first made him famous — *Lover, Fools Rush In,* etc.
3. **King of Swing: Vol. I** Benny Goodman and Original Orch., Trio, Quartet. *Ridin' High, Moonglow*—8 more.
4. **My Fair Lady** Original Broadway Cast recording with Rex Harrison and Julie Andrews. The complete score including *The Rain in Spain, I Could Have Danced All Night*—14 more.
5. **The Great Melodies of Tchaikovsky** Philadelphia Orch., Ormandy, conductor. 8 memorable selections.
6. **Moonlight Becomes You** Here's mood music in Hi-Fi — Paul Weston and his Music from Hollywood. 12 songs.
7. **Ellington Uptown** Duke Ellington and Orchestra perform *Skin Deep, The Mooche, Perdido*—2 more.
8. **Levant Plays Gershwin** 3 works—*Rhapsody In Blue; Concerto in F; An American in Paris.*
9. **Day By Day** Doris Day sings 12 popular songs—including *The Song Is You, Autumn Leaves,* etc.
10. **Rimsky-Korsakov: Scheherazade** Philadelphia Orch., Ormandy, conductor. A superb performance of this exotic score.
11. **Music of Jerome Kern** Andre Kostelanetz and his Orchestra play 20 Kern favorites.
12. **Concert by the Sea** Erroll Garner in an actual jazz performance at Carmel, Calif. *Teach Me Tonight, Where or When, I'll Remember April*—8 more.



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Spot Radio News

★ **Presenting latest information on the Radio Industry.**

By RADIO & TV NEWS
WASHINGTON EDITOR

CITIZENS RADIO, stalled for years by high-frequency and equipment-design-cost problems, may soon become a bustling activity, if a projected shift in frequency for the service comes to pass.

There is a move under way to shift the Citizens Radio band down to 27.12 mc. (± 160 kc.) and set up thirty-two 10-kc. channels here. Allowable powers now being discussed are 5 watts for most setups and 30 watts for those who want to use the service for light delivery-truck communications and other similar light commercial activities.

The vacated high bands, according to present plans, would be assigned to heavy commercial operation, involving larger, higher-power two-way systems.

MORE TV COVERAGE in the remote, sparsely settled areas of the West, may also become a reality this fall, if a ruling for low-power TV repeaters is finalized.

The repeater plan, which would replace the translator scheme and include booster stations, now called illegal, came about when Colorado Governor Steve McNichols told the Commission that v.h.f. booster systems are preferable and better adapted to western geographical conditions than u.h.f. translators.

The Governor said that the v.h.f. boosters are less expensive and offer a means of providing television service at a relatively low cost to the sparsely settled areas of the Far West, now without service. He pointed out that while translators may be desirable for other sections of the country, they are not suitable for the rugged, mountainous terrain found in the Far West. Accordingly, he urged the authorization of both translators and boosters, with each being employed where appropriate.

To gain the necessary information on booster effectiveness, the Governor suggested that the proponents of v.h.f. boosters be afforded an opportunity to demonstrate, by means of engineering evidence in a hearing, that v.h.f. boosters can be operated without causing harmful interference.

In issuing its notice for rule-making hearings, the FCC said that the new low-power repeaters would be allowed to operate on either v.h.f. or u.h.f., depending on local physical and economic conditions.

AN ENGINEERING STUDY, aimed at increasing the coverage and efficiency of CAA-operated airport surveillance radar, will be undertaken soon for the government by the *Airborne Instrument Laboratories.* The study will be conducted under a $43,550.40 contract awarded by the CAA.

Under the contract, the labs will investigate the limitations of existing airport surveillance radars and come up with suggestions as how best to increase the altitude and range of the equipment. In addition, recommendations will be made to improve the visibility of targets from small aircraft, when flying over fixed ground targets, and to reduce radio-frequency interference to and from adjacent radars.

Generally, existing CAA-airport surveillance radar has an operational range of 30 nautical miles and altitude coverage of up to 10,000 feet for small

NEW TELEVISION STATION GRANTS

An additional listing of new construction permits and changes that have been made in station call letters. List continued next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
South Dakota	Sioux Falls	——	13	210-216	28.87
Washington	Seattle	——	7	174-180	316

* ERP = (effective radiated power, kw.)

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twin-engine, propeller-driven aircraft.

AN ELECTRONIC ALTIMETER, accurate to within 40 feet at 60,000 feet altitude, has been developed for the U. S. Air Force by the Air Research and Development Command.

Designed for navigation, the altimeter will also be useful in aerial reconnaissance work and for applications where exact altitude above the earth's surface is a necessity in the accomplishment of a mission.

Major-General Thomas L. Bryan, Jr., Commander of ARDC's Wright Air Development Center where the project was conducted said that twelve service test models, manufactured by *RCA*, have successfully passed a year of flight testing.

The new altimeter determines an airplane's altitude by sending a radar signal to the ground and measuring the time it takes to return. This is then translated into feet and servomechanisms display the altitude on a standard altimeter dial.

The present types of electronic altimeters use a cathode-ray tube for data presentation, requiring an operator to read the scope and interpret it. The new instrument, known as the APN/42, not only gives an immediate reading, but its servo amplifiers can put readings on as many as three dials at once and the information can be fed to recorders, potentiometers, and other devices.

A highlight of the new equipment is its size. Contained in three units (transmitter, receiver, and antenna), the entire system can be fitted into a slot in the bottom of the plane. The control amplifier, containing the servo amplifier and timing circuits, can be placed anywhere in the plane and the indicator, which is only 3¾" square, can be fitted easily on the instrument panel. The scope used on current altimeters requires an opening which is 6½" x 6¾" and a depth almost twice that of the new altimeter's indicator.

There are thirty-five tubes in the new models which feature the use of etched-circuit panels throughout.

PERPLEXITY, PERSPIRATION, drama and comedy, are intermixed in the policing of the airways by the FCC. Not only does the Commission have to monitor the radio lanes constantly to see that users conform to technical requirements, but use its direction-finding network to track violators and sources of interference to communications and also to locate air and sea craft in distress.

The variety of cases that must be resolved by the FCC through its Field Engineering and Monitoring Bureau were detailed recently in an official information report.

In one case, cited by the FCC, an amateur was blamed by an Indiana housewife for interference to a TV set. Not satisfied when an FCC field inquiry indicated that the set was at fault rather than the ham, she then wrote to the (*Continued on page* 140)

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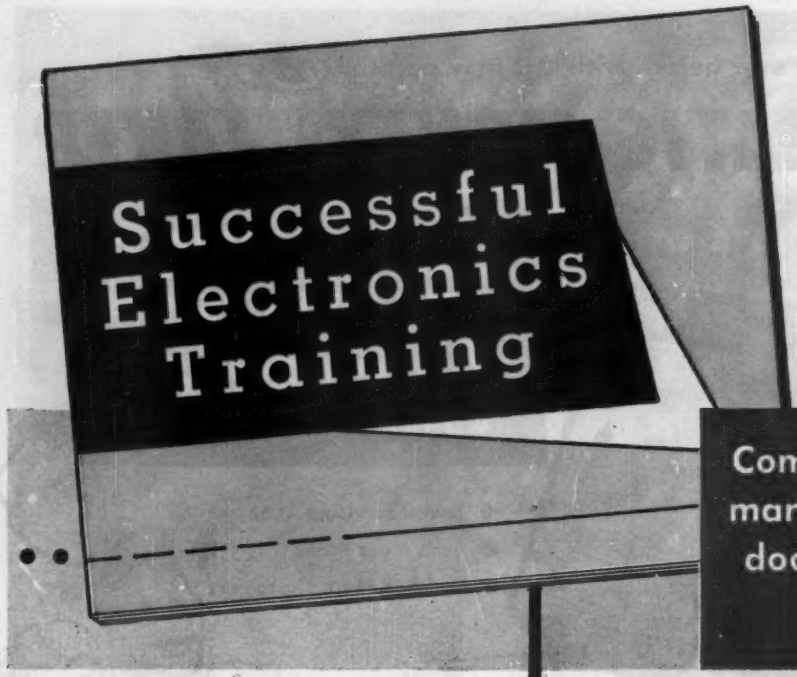

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James Glen:

When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. He was helping wire and install an interoffice phone system. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.

James S. Glen, Jr.
2920 Knob Hill Road
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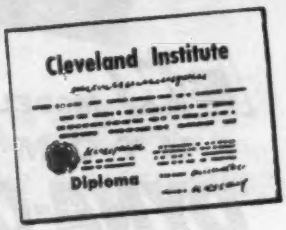

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Provides FM sound carrier. Has built-in audio tone generator plus input for tape, tuner, mike

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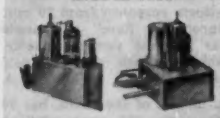
MODEL 1000



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Facilitates servicing, installation or demonstration of black & white and color TV receivers. Provides closed-circuit TV system with both video and audio for commercial, industrial, and educational applications. Allows convenient stand-by and break-in, or distribution line check, for community antenna system operation.

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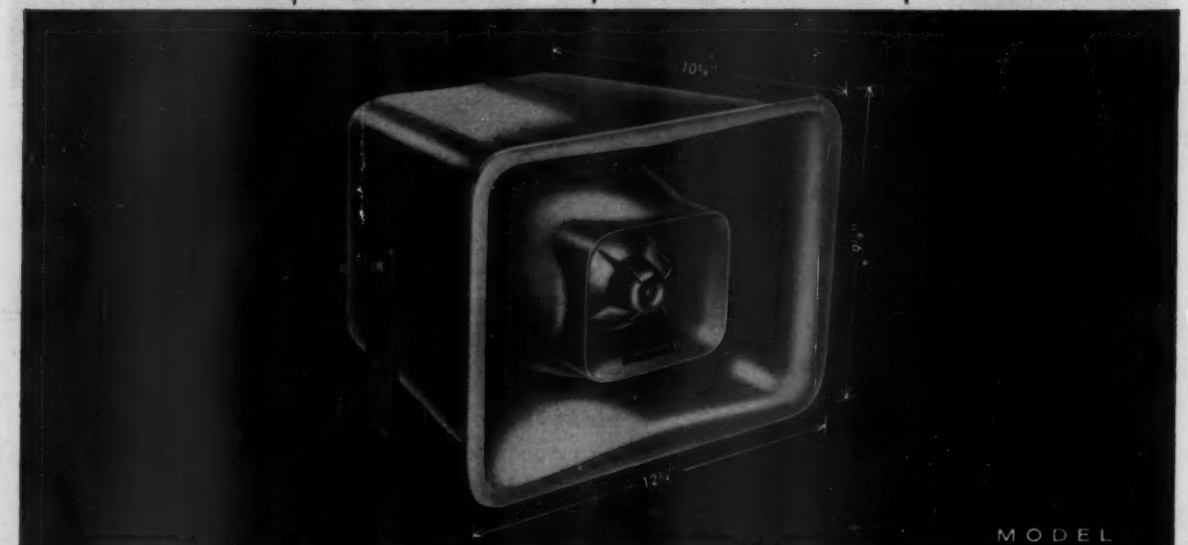
In paging applications, the MLC penetrates high noise levels . . . its wide frequency range adds deep richness to music reproduction. Here's double duty, double value!



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Now...real high fidelity never before available in a rugged, small size, weatherproof speaker system. Unique wide-angle, dual folded horn design with separate low and high frequency drivers. Dependable, easy to install, low in cost, the MLC offers these outstanding features:

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MORE DEPENDABLE: Experienced mechanical engineering and careful electrical design meet the challenge of diversified application and environmental hazards. Rugged and conservatively rated—you can *rely* on the MLC.

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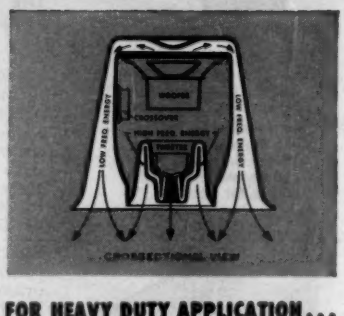

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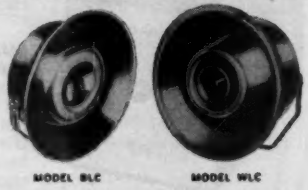

MODEL BLC MODEL WLC

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MODEL WLC, largest of the series, has 30 watt power capacity, 12" super-efficient woofer with response from 50 cycles, heavy duty radial tweeter . . . and a decade of successful performance in concert halls, rinks, auditoriums, stadiums and outdoor theaters throughout the world. **$250.00 List.**

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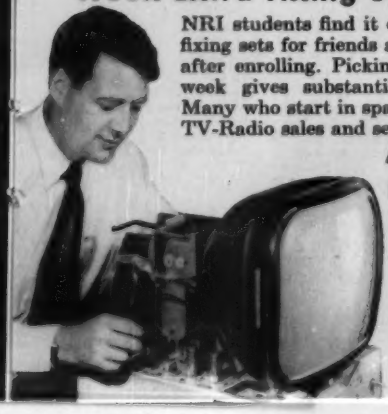
People *look up to* and depend on the Technician, more than ever before. Offices, plants, homes everywhere are obliged to buy his knowledge and services. His opportunities are great and are increasing. Become a TV-Radio Technician. At home, and in your spare time, *you* can learn to do this interesting, satisfying work—qualify for important pay. To ambitious men everywhere *here* in the fast growing Television-Radio field is rich promise of fascinating jobs, satisfaction and prestige as well as increasing personal prosperity.

Increased Opportunities in Growing Field

A steady stream of new Electronic products is increasing the job and promotion opportunities for Television-Radio Technicians. Right now, a solid, proven field of opportunity for good pay is servicing the tens of millions of Television and Radio sets now in use. The hundreds of TV and Radio Stations on the air offer interesting jobs for Operators and Technicians.

More Money Soon—Make $10 to $15 a Week Extra Fixing Sets in Spare Time



NRI students find it easy and profitable to start fixing sets for friends and neighbors a few months after enrolling. Picking up $10, $15 and more a week gives substantial extra spending money. Many who start in spare time soon build full time TV-Radio sales and service businesses.

Act Now—See What NRI Can Do for You

NRI has devoted over 40 years to developing simplified practical training methods. You train at home. Get practical experience, learn-by-doing. Address: **NATIONAL RADIO INSTITUTE, Washington 16, D. C.**

NRI Has Trained Thousands for Successful Careers in TV-Radio

Studio Engr., Station KATV
"I am now Studio Engineer at Television Station KATV. Before enrolling for the NRI Course, I was held back by limitation of a sixth grade education." BILLY SANCHEZ, Pine Bluff, Ark.

Has All the Work He Can Do
"Since finishing NRI Course I have repaired more than 2,000 TV and Radio sets a year. NRI training certainly proved to be a good foundation." H. R. GORDON, Milledgeville, Ga.

Has Good Part Time Business
"Quite early in my training I started servicing sets. Now have completely equipped shop. My NRI training is the backbone of my progress." E. A. BREDA, Tacoma, Wash.

The Tested Way To Better Pay

See Other Side ☛

CUT OUT AND MAIL CARD NOW

SAMPLE LESSON AND CATALOG BOTH FREE

NO STAMP NEEDED!
WE PAY POSTAGE

This card entitles you to Actual Lesson on Servicing, shows how you learn Television-Radio at home. You'll also receive 64-Page Catalog.

NATIONAL RADIO INSTITUTE, Dept. A B
Washington 16, D. C.

Please mail me the FREE sample lesson and 64-Page Catalog. (No Salesman will call.)

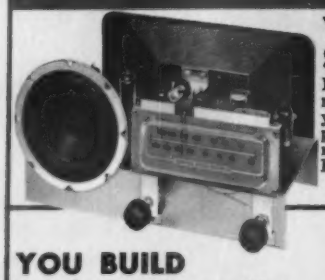
Name..... Age.....

Address.....

City..... Zone..... State.....

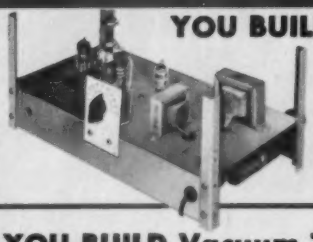
ACCREDITED MEMBER, NATIONAL HOME STUDY COUNCIL

Technical "KNOW-HOW" Can Give You Interesting, Important Work
LEARN-BY-DOING with Kits NRI Sends at No Extra Charge



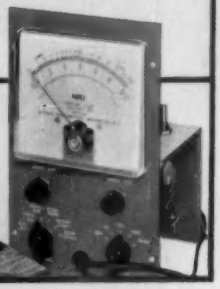
YOU BUILD AC-DC Superhet Receiver

NRI Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.



YOU BUILD Signal Generator

You build this Signal Generator. Learn how to compensate high frequency amplifiers, practice aligning typical I.F. amplifiers in receiver circuits. Make tests, conduct experiments.



YOU BUILD Broadcasting Transmitter

As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

For Higher Pay, Better Jobs
Be a Television-Radio Technician

Servicing Needs More Trained Men

Portable TV, Hi-Fi, Transistor Radios, Color TV are making new demands for trained Technicians. Good opportunities for spare time earnings or a business of your own.

Broadcasting Offers Satisfying Careers

4000 TV and Radio stations offer interesting positions. Govt. Radio, Aviation, Police, Two-Way Communications are growing fields. Trained Radio-TV Operators have a bright future.

J. E. Smith, Founder

Train at Home the NRI Way Famous for Over 40 Years

NRI is America's oldest and largest home study Television-Radio school. The more than 40 years' experience training men for success, the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, from coast to coast, in small towns and big cities. You train in your own home, keep your present job while learning. Many successful NRI men did not finish high school. Let us send you an actual lesson, judge for yourself how easy it is to learn.

No Experience Necessary—NRI Sends Many Kits for Practical Experience

You don't have to know anything about electricity or Radio to understand and succeed with NRI Courses. Clearly written, well-illustrated NRI lessons teach TV-Radio-Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available. Address: **NATIONAL RADIO INSTITUTE, Washington 16, D. C.**

NRI Graduates Do Important Work

Now Quality Control Chief "Had no other training in Radio before enrolling, obtained job working on TV amplifiers before finishing course. Now Quality Control Chief." T. R. Favalobo, Norwich, N. Y.

NRI Course Easy to Understand "I opened my own shop before receiving my diploma. I have had to hire extra help. I am independent in my own business." D. P. Cressey, Stockton, Cal.

Works on Color-TV "NRI changed my whole life. If I had not taken the course, probably would still be a fireman, struggling along. Now Control Supervisor at WRCA - TV." J. F. Meline, NewYork, N Y.

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P. L. & R.)
Washington, D.C.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE

Washington 16, D. C.

SAMPLE LESSON
64-page CATALOG
both FREE

See Other Side for more information on the Tested Way to Better Pay

ence, learn-by-doing. Address: NATIONAL RADIO INSTITUTE, Washington 16, D. C.

Address .....
City ..... Zone ..... State .....
ACCREDITED MEMBER, NATIONAL HOME STUDY COUNCIL

Your Independent Service Advertising Program expands with your purchases of CBS tubes

One of a new series of full-page ads appearing in TV GUIDE

This family cook is your independent service-dealer. He's that busy neighbor who somehow finds time to be scoutmaster of his son's troop. He has his radio and TV service business in your town . . . and he knows he'll stay in business there only as long as he does superior work. In fact, when he works for you, he bets his family's bread and butter he'll do a better job . . . and he will.

for your radio and TV repairs, call the man who cares... your INDEPENDENT SERVICE-DEALER

He actually bets his family's bread and butter he'll do a better job for you . . . his business success depends upon it.

He is a highly skilled technician, trained and equipped to service promptly *all makes* of radio and TV sets at a fair price. So next time your radio or TV needs repairs, call the man who cares. Call your *independent* service-dealer.

Look for this emblem . . .

Whenever your set needs a new tube, ask to have it replaced with a CBS tube. There are no better tubes made.

For the best in entertainment tune to CBS.

©CBS-HYTRON, Danvers, Mass.
A Division of Columbia Broadcasting System, Inc.

We know you like your Independent Service Program and want it expanded. We know it from a nation-wide survey . . . and from your increasing purchases of CBS tubes. May we remind you: each time you buy CBS tubes, you support your own independent service-dealer campaign. Keep it going . . . keep it growing . . . always specify CBS tubes.

SUPPORTING MATERIAL ALSO EXPANDS

- "The Independent Service Business and Your Future" booklet
- Independent Service decal
- 10 new postal cards
- 16 new advertising mats
- Radio and television scripts
- Consumer booklet "On the Care of a Television Set"

Ask your CBS Tube distributor for this tie-in material . . . or write for illustrated broadside PA-181.

CBS-HYTRON—Danvers, Massachusetts
A Division of
Columbia Broadcasting System, Inc.

FOR THE BEST IN ENTERTAINMENT TUNE TO CBS

Washington 16, D. C.

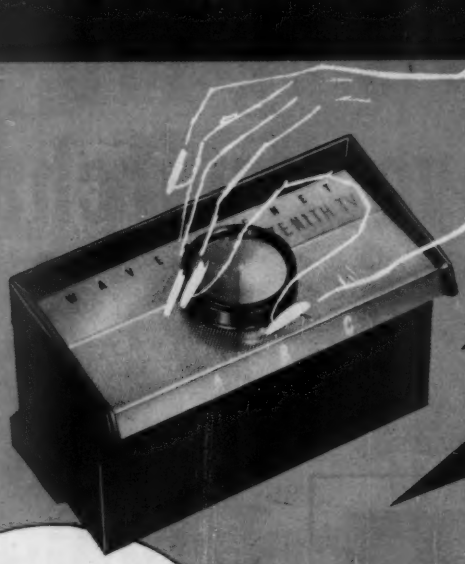
64-page CATALOG both FREE

Information on the Tested Way to Better Pay

NEW PLUS PROFIT ITEM FOR SERVICE DEALERS!

FITS ON BACK OF ANY SET!

INSTALL IN SECONDS!



NEW!

Sell the sensational ZENITH®

WAVEMAGNET® INDOOR TV ANTENNA

$14.95 SUGGESTED RETAIL

EXTRA BIG PROFIT MARGIN FOR YOU!

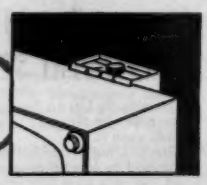
FITS ANY TELEVISION SET!

Sales potential unlimited!

Low Cost . . . big mark-up . . . powerful sales appeal . . . easy-to-handle self-selling package . . . beautiful styling that complements any TV set . . . the new Zenith Wavemagnet® Indoor TV Antenna will bring you important extra profits.

It obsoletes awkward, unsightly "rabbit ear" and "corkscrew" antennas; viewer *dials* in the clearest, sharpest TV picture with simplified one-knob control. Fits neatly and inconspicuously behind *any* TV set . . . table models, consoles . . . makes portable TV sets *really* portable. Installed in seconds with just two screws. Part No. S-42592.

The only really NEW TV antenna. Demonstrate it . . . it sells on sight!



See your Zenith distributor or, for full information, write

ZENITH RADIO CORP. • PARTS AND ACCESSORIES DIVISION

6001 W. Dickens, Chicago 39, Ill.

QUALITY BY

Zenith

the Royalty of Television

GET IN ON THE TV BOOM!

L. C. Lane, B.S., M.A. President, Radio-Television Training Association. Executive Director, Pierce School of Radio & Television.

TRAIN FOR A TOP-PAY JOB AS A TELEVISION TECHNICIAN

NO PREVIOUS EXPERIENCE NEEDED — study AT HOME in your SPARE TIME

Next to the atom and hydrogen bombs, the biggest noise being made today is by the booming radio-television-electronics industry.

***Now,* while the boom is on in full force, is the time for you to think about how you can share in the high pay and good job security that this ever-expanding field offers to trained technicians.**

Just figure it out for yourself. There are more than 400 television broadcasting stations operating right now and hundreds more to be built; more than 34 million sets in the country and sales increasing daily. Soon moderately priced color television sets will be on the market and the color stampede will be on.

All these facts mean that good jobs will be looking for good men. You can be one of those men if you take advantage of my training *now* — the same training that has already prepared hundreds of men for successful careers in the radio-television-electronics field.

No experience necessary! You learn by practicing with professional equipment I send you. Many of my graduates who now hold down good paying technician jobs started with only grammar school training.

If you have previous Armed Forces or civilian radio experience you can finish your training several months earlier by taking my FM-TV Technician Course. Train at home with kits of parts, plus equipment to build YOUR OWN TV RECEIVER. ALL FURNISHED AT NO EXTRA COST!

After you finish your home study training in the Radio-FM-TV Technician Course or the FM-TV Technician Course you get two weeks, 50 hours, of intensive Laboratory work on modern electronic equipment at our associate school in New York City, Pierce School of Radio & Television.

COLOR TV TECHNICIAN COURSE—All new! Learn the latest. Be prepared for those Color TV servicing profits ahead! Contains the most up-to-date servicing data, procedures and circuits. For men with radio or TV training or experience.

RADIO-FM-TV TECHNICIAN TRAINING

FM-TV TECHNICIAN TRAINING

Sylvania Now Sponsoring RTTA's Color TV Technician Course

One of the nation's largest electronics manufacturers and marketers Sylvania Electric Products Inc. in its continuing effort to cooperate with independent service dealers is now sponsoring the RTTA Color Television Technician Course. Available to Authorized Sylvania Dealers.

VETERANS!

My School fully approved to train Veterans under new Korean G. I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

LEARN BY DOING

As part of your training I give you the equipment you need to set up your own home laboratory and prepare for a BETTER-PAY TV JOB. You build and keep an Electromagnetic TV RECEIVER designed and engineered to take any size picture tube up to 21-inch, (10-inch tube furnished. Slight extra cost for larger sizes.) . . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power supply. Everything supplied, including all tubes.

EARN WHILE YOU LEARN! Almost from the very start you can earn extra money while learning by repairing radio-TV sets for friends and neighbors. Many of my students earn enough each week to pay for their entire training from spare time earnings . . . start their own profitable service business.

FCC COACHING COURSE Qualifies you for Higher Pay! Given to all my students AT NO EXTRA COST. Helps you qualify for the TOP JOBS in Radio-TV that demand an FCC license! Full training and preparation at home for your FCC license.

YOU GET THESE *free!*

MAIL THIS COUPON TODAY!

Radio-Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veterans Training

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
Dept. RT-10D, 52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Send me your NEW FREE BOOK, FREE SAMPLE LESSON that will show me how I can make TOP MONEY IN TELEVISION. I understand I am under no obligation.

(PLEASE PRINT PLAINLY)

Name_____ Age_____

Address_____

City_____ Zone____ State_____

☐ Color TV Technician Course
☐ Radio-FM-TV Technician Course
☐ FM-TV Technician Course
☐ TV Studio Technician Course

VETERANS! Write discharge date

FOR PROFITABLE PICTURE TUBE SALES

If you buy Newcomb or sell Newcomb, you profit from Newcomb's *proven* dependability. First of all, Newcomb products earn their place in the sun by their superior sound. But the quality that accounts for Newcomb's position as probably the largest independent manufacturer in the field is *dependability*. The user owns equipment that is always ready to operate, ready to go to work from the minute it is installed. The dealer is not plagued with a series of profit-eating service calls. And, he gains the invaluable asset of a satisfied customer. Newcomb dependability is the result of highly-refined conventional circuitry, quality parts, thorough testing, and meticulous reworking until Newcomb products meet Newcomb standards—the highest in the audio industry. The tried and true conventional circuitry found in Newcomb products not only adds to their dependability, but also is readily understood by the maintenance technician. "Dependability" is a characteristic that cannot be established by a simple assertion. Dependability must be proved over a period of time. In twenty years Newcomb Audio Products Co. has proved its ability to deliver maximum dependability combined with superior sound... *consistently.*

NEWCOMB

DEPENDABLE NEWCOMB PUBLIC ADDRESS AMPLIFIERS

are designed for continuous heavy duty, safety, simplicity of operation. Although specifically designed for use in school and civic auditoriums, their flexibility and dependability have led to an impressive variety of applications—in radio and television stations, government projects, sports events... The Newcomb Custom KX-50 shown here is the finest public address amplifier ever offered—without equal at any price. A 50 watt unit with less than 3% distortion, full remote control, double-acting separate bass and treble controls, bandwidth selector, dual electronic eye volume and overload indicator... Write for free catalog containing complete description.

dependability

DEPENDABLE NEWCOMB HIGH FIDELITY COMPONENTS

are noted for their exceptional, continuous reliability and brilliant performance. Newcomb has concentrated on the qualities of sound reproduction most desirable for home entertainment, reduced distortion and hum to the vanishing point, increased the flexibility of control, achieved outstanding beauty in appearance. Finest of all compact-styled units are the flexible Newcomb Compact 1020 preamplifier-control unit-power amplifier and the sensitive, stable Newcomb Compact 200 AM-FM Radio Tuner.

DEPENDABLE NEWCOMB RECORD AND TRANSCRIPTION PLAYERS

have earned an unchallenged reputation for reliability and safety in many of the leading public school systems throughout the nation. Ruggedly built, with excellent audio quality, they represent the greatest value available in this field today. Newcomb Record Players have gained wide acceptance for church activities and Sunday schools, in dance schools, and among square dance callers. Only American made parts are used in this equipment. All Newcomb products bear the Underwriters Laboratories labels.

Write for free catalog of products in which you are interested

Since 1937 Hollywood's leading producer of precision products for the control and amplification of sound.

NEWCOMB AUDIO PRODUCTS COMPANY Department F-10
6824 Lexington Avenue • Hollywood 38, California

A LIMITED NUMBER OF DEALERSHIPS IN A FEW AREAS ARE OPEN. WRITE FOR DETAILS

FOR PROFITABLE PICTURE TUBE SALES

IT TAKES TWO—RCA and YOU!

Silverama Picture Tube sales are zooming, because you're recommending and installing Silverama replacement Picture Tubes. Sales are zooming, too, because we're making RCA Picture Tubes better than ever, and telling your customers so—in ads like these. Have you seen these week-after-week ads in LIFE, SATURDAY EVENING POST, TV GUIDE? They reach over 40 million people every insertion.

"Daddy... you mean to tell me that's our old TV?"
Don't wait until the tube goes. Replace now with an
RCA
Silverama
SUPER-ALUMINIZED RCA PICTURE TUBE
"you mean to tell me that's your old TV?"
Don't wait until the tube goes. Replace now with an
RCA
Silverama
SUPER-ALUMINIZED RCA PICTURE TUBE
"you mean to tell me that's our old TV?"
Don't wait until the tube goes. Replace now with an
RCA
Silverama
SUPER-ALUMINIZED RCA PICTURE TUBE

Take a selling tip from RCA's advertising! Don't sell your customers a picture tube. Sell them *"A BETTER PICTURE"* —with an RCA Silverama Picture Tube, naturally.

RCA PICTURE TUBES

RADIO CORPORATION OF AMERICA

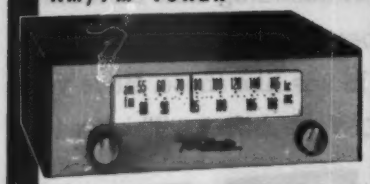
Electron Tube Division, Harrison, N. J.

RCA ELECTRON TUBES
Authorized Dealer
TV-RADIO SERVICE
Cash in on RCA's Silverama advertising by displaying this sign. Your RCA distributor will tell you how to qualify.

Tele Matic

CUSTOM HIGH FIDELITY KITS

AM/FM TUNER



2 uv for 20 DB quieting, AFC plus Defeat, Full Frequency Response, 300 KC bandwidth.
Model KC-400 Less Cage $34.95 (FED. EX. TAX INC.)
Wired and Tested 59.95

20-WATT INTEGRATED AMPLIFIER

Power Response CONSTANT at 20 Watts, 1 ± DB Full Frequency Response, Infinite Equalization Bass Treble Controls; 3 Hi, 1 Low inputs.
Model KC-401 Less Cage $48.00
Wired and Tested 64.95

Exclusive! STEREOPHONIC KITS

AM/FM STEREOPHONIC TUNER WITH WIRED FM FRONT END

NEW DIMENSIONS IN SOUND—Each section used individually or together—0.9 uv for 20 DB quieting, 330 kc Bandwidth 3-gang variable AM tuning, 15 uv per meter loop sensitivity.
Model KB-402 Less Cage $89.95 (FED. EX. TAX INC.)
Wired and Tested 99.50

40-WATT STEREOPHONIC AMPLIFIER

NEWEST DEVELOPMENT IN STEREOPHONIC SOUND FOR THREE DIMENSIONAL LIFE-LIKE REALISM!
Twin 20-Watt Channels—Each with FULL PRE-AMP sections and Master Volume Control.
Model KB-403 Less Cage $ 82.50
Wired and Tested 109.50

For full details, see your local dealer or write

TELEMATIC INDUSTRIES, INC.
16 HOWARD AVENUE, BROOKLYN 21, N. Y.

Within the Industry

LOUIS H. COHEN has joined the components division of *International Telephone and Telegraph Corporation* as general sales manager of semiconductors.

Prior to joining the organization, Mr. Cohen spent considerable time as a manufacturer's representative for leading electrical and electronic component producers in Canada. He also headed his own distributor business which specialized in the sale, import, and export of electrical components and equipment. He then joined *Philco Service, Inc.*, where he was the general manager.

In his new position, Mr. Cohen will supervise, on a nation-wide basis, the sales activities of the semiconductor division of the firm's components division.

He is a member of the Institute of Radio Engineers.

* * *

MAX L. HAAS, late chairman of the board *of Bud Radio, Inc.*, has not been forgotten by his friends in the industry.

A memorial scholarship fund has been established in his honor at Case Institute of Technology. This fund is for the benefit of students in the field of electronics.

Secretary of the committee to administer the fund is Herbert L. Wright, National City Bank Building, Cleveland 14, Ohio.

Mr. Haas had been identified with the radio, television, and electronics industry since 1928. He was also president of *Cadillac Fabricators, Inc.* and treasurer of *Radio Electronics Parts Corporation.*

* * *

DR. THORNTON C. FRY has been appointed vice-president and director of "Univac" engineering for the *Remington Rand Division* of *Sperry Rand Corporation.*

He was formerly assistant to the president of *Bell Telephone Laboratories* and has been a consultant to *International Telephone and Telegraph Corp.*, and *Remington Rand.* During World War II he was a member of the National Defense Research Committee and deputy chief of its Applied Mathematics Panel. He was awarded the Presidential Certificate of Merit for these activities.

In his new position, Dr. Fry will direct all research, development, and product planning of commercial and military "Univac" systems and equipment.

* * *

WEST COAST ELECTRONIC MFRS. ASSOCIATION recently released figures indicating that the western electronics industry is still growing at a rapid rate.

Calvin K. Townsend, president of the association and executive vice-president of *Jennings Radio* stated that the west had 15% of the nation's electronic firms, 17% of the employment, and 24% of the sales at the end of 1956.

Electronic firms in the San Francisco area expect to increase their 1956 plant capacity of 3,500,000 square feet by 50% and increase 1956 sales by 41% by the end of 1957. Hugh P. Moore, vice-president of the organization and board chairman of *Lerco Electronics*, stated that Los Angeles had 11.2% of the firms, 11.9% of the employment, and 15% of the sales of the national industry.

* * *

GLEN McDANIEL, president-emeritus of the RETMA and former vice-president of *RCA*, has been appointed to the board of directors of *Litton Industries.*

Mr. McDaniel has been associated with the electronics industry since 1946 when he joined *RCA Communications, Inc.* as vice-president. Appointed a vice-president of the parent organization in 1948, he was also chairman of the firm's Washington Coordinating Committee and a member of its Patent Policy Committee.

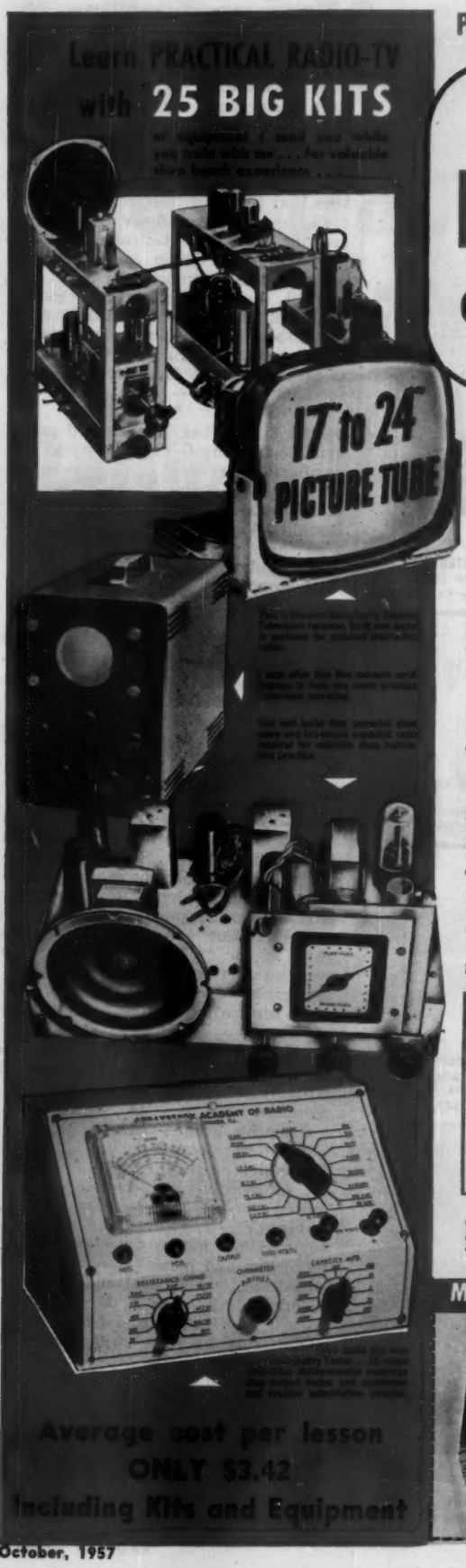
In 1951 he was selected as RETMA's first full-time president, serving in that capacity for four years. He also served as its general counsel for five years. In recognition of his many services to the association, its board of directors created the title of President-Emeritus.

An attorney, Mr. McDaniel is a partner in the New York law firm of *Lundgren, Lincoln and McDaniel.*

* * *

RADIO-ELECTRONICS-TELEVISION MANUFACTURERS ASSOCIATION members voted overwhelmingly to change the name of the 33-year-old industry organization to the Electronics Industries Association. The name change will become effective upon approval of a charter revision by the State of Illinois where the association is incorporated.

Prepare for a Good Paying Job—Or Your Own Business



"I Will Train You at Home in RADIO-TELEVISION On Liberal No Obligation Plan!"

Frank L. Sprayberry
Educational Director

New Equipment! New Lessons! Enlarged Course! The true facts are yours in my big new catalog . . . YOURS FREE . . . JUST MAIL COUPON!

I can train and prepare you in as little as 10 months to step into the big opportunity Radio-Television service field. Train *without* signing a binding contract . . . without obligating yourself to pay any regular monthly amounts. You train entirely at home in spare hours . . . you train as fast or as slowly as you wish. You'll have your choice of THREE SPRAYBERRY TRAINING PLANS . . . planned for both beginners as well as the more experienced man. Get the true facts about the finest most modern Radio-Training available today . . . just mail the coupon for my big new 56 page fact-filled catalog plus sample lesson—both FREE.

Train the Practical Way--with Actual Radio-Television Equipment

My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment . . . all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My students are completely trained Radio-Television Service Technicians.

NEWEST DEVELOPMENTS

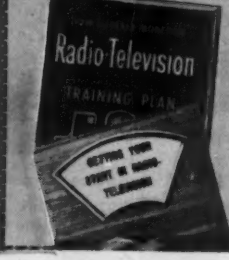
Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

See for Yourself . . . Make Your Own Decision . . . Mail Coupon Today!

The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts . . . to see that I actually illustrate every item I include in my training. With the facts in your hands, you will be able to decide. *No salesman will call on you.* The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
1512 Jarvis Avenue, Dept. 25-T, Chicago 26, Illinois

Mail This Coupon For Free Facts and Sample Lesson



SPRAYBERRY ACADEMY OF RADIO-TELEVISION
1512 Jarvis Ave., Dept. 25-T, Chicago 26, Ill.

Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that *no salesman will call upon me.* Include New Catalog and Sample Lesson FREE.

Name_____ Age____

Address_____

City_____ Zone____ State____

PRECISION

...manufacturers of fine electronic test instruments for over 25 years...

INTRODUCES

PACO

quality test instruments in **kit form**

For the first time—
a line of test instrument kits engineered and produced under the auspices of a major test equipment manufacturer... and conveniently available directly from your own local electronic parts distributor.

PRECISION's
25 years of experience is your assurance of PACO's superior quality, styling, performance and value.

Model V-70
VACUUM TUBE VOLTMETER KIT
wide-range • peak to peak.
Net Price: $31.50

Model B-10; BATTERY ELIMINATOR KIT
• less than 0.3% ripple output.
• no external filter adaptors required.
Net Price: $41.95

Model S-50
5" CATHODE RAY OSCILLOSCOPE KIT
push-pull vertical and horizontal amplifiers.
Net Price: $47.50

COMING SOON...

Model G-30 —RF Signal Generator
Model Z-80 —Audio-RF Signal Tracer
Model M-40—High Sensitivity V-O-M

Model C-20
RESISTANCE – CAPACITY-RATIO BRIDGE KIT
10 mmfd to 2000 mfd
½ ohm to 200 megohms.
Net Price: $20.95

Model T-60; TUBE CHECKER KIT
full free-point lever selector system.
Net Price: $36.75
Matching, hinged, removable cover.
Net Price: $3.95

Available and on display at leading electronic parts distributors. Write for descriptive bulletin.

PACO ELECTRONICS CO., INC.
70-31 84th Street, Glendale 27, L. I., N. Y.

A DIVISION OF *PRECISION* Apparatus Company, Inc.

Export: 458 Broadway, New York 13, New York
Canada: Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto 10, Ont.

The new name of the national electronic manufacturers organization marks the fourth change since its founding in Chicago in 1924 as the Radio Manufacturers Association. In 1950 "Television" was added, and in 1953 "Electronics".

According to James D. Secrest, executive vice-president, the change reflects "the majority view of our members that the term 'electronics' is generally understood as descriptive of the growing variety of electronic products including older radio and television equipment and components."

Until the name Electronic Industries Association is well established, all association literature will carry the notation "formerly Radio-Electronics-Television Manufacturers Association".

* * *

ELMER B. OTT has been elected president of the *Ray-O-Vac Company.* He replaces former president and chairman of the board, Donald W. Tyrell, who has resigned the presidency but will continue as board chairman.

Mr. Ott joined the company in 1923 and has held many different positions, serving as senior vice-president for administration and finance since 1952.

As president, he will have the responsibility for over-all direction and management of the company's foreign and domestic operations.

* * *

SPRAGUE PRODUCTS COMPANY, North Adams, Mass., recently received its fourth "Friends of Service Management Award" from the National Alliance of Television and Electronic Service Associations.

The citation received by the company is for "outstanding service in creating better customer relations" between set owners and the television-radio service industry.

* * *

WALTER B. MANSON, JR., has been named assistant to the president of *Measurements Corporation.*

Since his graduation from Cornell University in 1936, Mr. Manson has acquired broad experience in the engineering, manufacturing, and merchandising of electrical and electronic products of *Thomas A. Edison Industries* of *McGraw-Edison Company.*

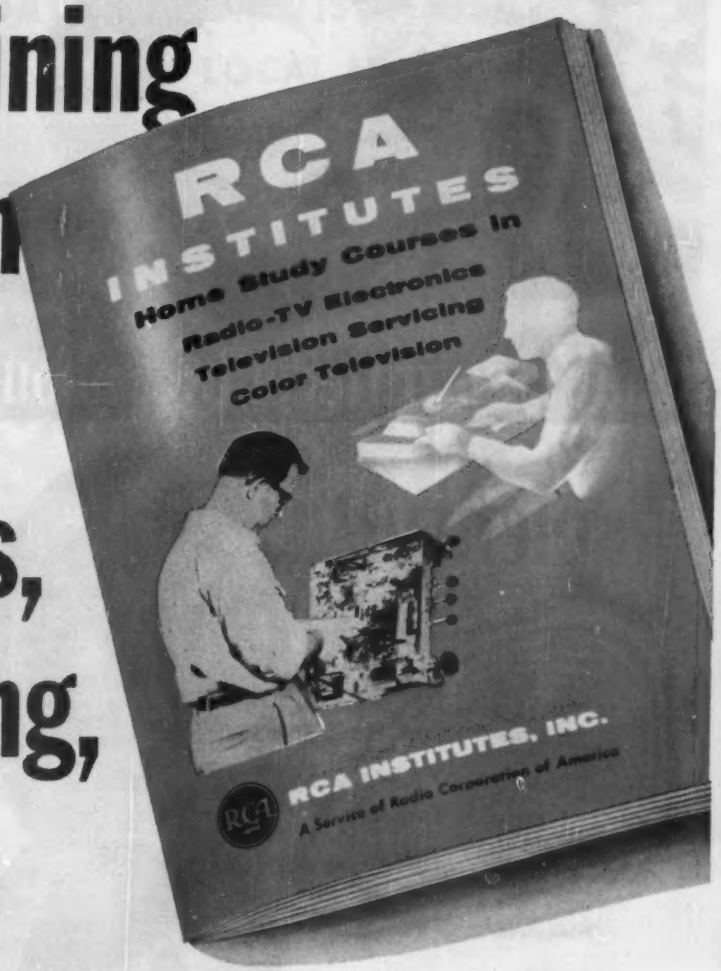
He joins his new organization in connection with its program of expansion to fill the need for laboratory standards.

* * *

THE INSTITUTE OF HIGH FIDELITY MANUFACTURERS, INC., announces its removal from Mineola, Long Island, to new and larger quarters at 125 East

(*Continued on page* 123)

RCA offers you the finest training at home in Radio–TV electronics, TV servicing, Color TV



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350 WEST FOURTH STREET, NEW YORK 14, N.Y.
In Canada—RCA Victor Company, Ltd.,
5001 Cote de Liesse Rd., Montreal 9, Que.

plenty.....

to this 12" extended range Wigo ($59.50) ...

you can add cone tweeter array ($20.00) — or buy the complete two-way system initially ($79.50)

Prices slightly higher West of Rockies

25 to 18,000 cps.

....their exclusive "CLIMATE-PROOF-CONSTANT RESPONSE

voice coil and cone suspension" assures you of constantly fine sound quality... whether you're in Maine or Florida! Cast aluminum frame and hyperbolic cone design mark the Wigo as a *premium quality* speaker. All this... plus the fact that the Wigo way is a wonderful way for your hi-fi system to grow up! It lets you enjoy the best quality *now* ... and all the quality you'd ever want *in the future!* It's worth listening to a Wigo! Write for catalog.

expand further with other Wigo additions... 8" mid-range Wigo 16" super-woofer

wonderful WIGO speakers

United Audio Products (Div. of United Optical Mfg. Corp.), 202 East 19th Street, New York 3, N. Y.

millions of people will read powerful, large-space ads in

★ NATIONAL MAGAZINES

★ SUNDAY SUPPLEMENTS IN 164 KEY CITIES

★ LOCAL NEWSPAPERS

CHANNEL MASTER

Launches Another Dynamic

NATIONAL ADVERTISING CAMPAIGN

Once again Channel Master uncorks a massive national advertising drive to help you sell more outdoor antenna installations. These ads provide powerful sales support — right in your own local area . . . sparking new and replacement outdoor antenna installations . . . creating store traffic . . . promoting regular antenna check-ups.

featured in NEW NATIONAL ADS

CHANNEL MASTER® T-W ANTENNA

The revolutionary new T-W is America's largest selling outdoor antenna. In gain, front-to-back ratio and mechanical strength, the T-W is unequalled by any other Broad Band antenna. Available in 7, 5, and 3-element models.

® Reg. U.S. Pat. Office and Canada

HOW YOU CAN WIN PRESTIGE and PROFITS WITH THIS CAMPAIGN

Sell a "Complete Channel Master Installation"

Consistent, big-space national advertising has created strong consumer preference for all Channel Master products. That's why it's now more profitable than ever for you to sell a "complete Channel Master installation"— featuring Channel Master masting, guy wire, transmission line, standout insulators, etc.

Identify Yourself as a Channel Master Dealer

Customers have confidence in you when you sell the brand they know best — and Channel Master is the only nationally advertised brand of TV antennas and accessories. Identify yourself with the leader. Display the prestige-building Channel Master banners, streamers, antenna check-up charts, and other materials. Available thru your local Channel Master Distributor. Call him Now!

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WORLD'S LARGEST MANUFACTURER OF TV ANTENNAS AND ACCESSORIES

NEW!
streamlined motor unit and modernistic control cabinet

handsome modern design for modern setting ... by the nation's leading designer

TR-15 and TR-16

CDR ROTORS

- quick mounting antenna mast collet
- speedy installations . . . no loose parts to assemble
- takes antenna masts up to 1½" O.D.—self-centering saw tooth clamps
- instant locking . . . WILL NOT DRIFT
- mechanical brake that is released magnetically
- instantly reversible . . . makes complete revolution in 45 seconds
- passes rigid J.A.N. spec. salt water test
- modern design offers minimum wind resistance
- high strength with low weight
- fits standard towers
- completely weather-sealed
- mahogany or blond finish

THE RADIART CORP.
CLEVELAND 13, OHIO

CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J.

Shown at Bell Laboratories, Murray Hill, N. J., are, left to right, F. J. Herr, S. T. Brewer, L. R. Snoke, E. E. Zajac and F. W. Kinsman.

They're wiring the seas for sound

These five Bell Labs scientists and engineers may never "go down to the sea in ships." Yet, they're part of one of the most exciting sea adventures of modern times. Along with many other specialists, they are developing the deep-sea telephone cable systems of the future.

Here's how they join many phases of communications science and engineering—to bring people who are oceans apart within speaking distance.

F. J. Herr, M.S., Stevens Institute, is concerned with systems design and analysis. He studies the feasibility of new approaches and carries out analysis programs to select optimum parameters for a proposed system design.

S. T. Brewer, M.S. in E.E., Purdue, communications and electronics engineer, explores new designs for sea-bottom amplifiers needed to step up power of hundreds of simultaneous telephone conversations.

L. R. Snoke, B.S. in Forestry, Penn State, is the team biologist. He investigates the resistance of materials to chemical and microbiological attack in sea water. Materials are evaluated both in the laboratory and in the ocean.

E. E. Zajac, Ph.D. in Engineering Mechanics, Stanford, is a mathematician. He studies the kinematics of cable laying and recovery. Cable's dynamic characteristics, ship's motion, the mountains and valleys in the ocean bottom—all must be taken into account.

F. W. Kinsman, Ph.D. in Engineering, Cornell, solves the shipboard problems of storage, handling and "overboarding" of cable. New machinery for laying cable is being developed.

Deep-sea cables once were limited to transmitting telegraph signals. Bell Labs research gave the long underseas cable a voice. New research and development at the Labs will make this voice even more useful.

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NO FINGERNAIL FUMBLING!

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fluxvalve

FLUXVALVE TWIN SERIES 350 – A turn-over cartridge providing a rapid change of stylus point radius. Available in 12 models featuring many combinations of styli, prices start at a modest $24.

FLUXVALVE SINGLE SERIES 370 – A miniature high quality cartridge for use in any type of auto-changer or manual player arm. Available in 5 models, prices start at a low $17.85.

The **FLUXVALVE** features exclusive hum rejection circuit – **requires no adjustment!**

PICKERING'S introduction of the *truly* miniature FLUXVALVE magnetic phonograph cartridge represents a new era in high fidelity cartridge design. This newest of PICKERING cartridges brings the music lover the most exciting and *safest* idea in a stylus assembly since PICKERING introduced the first lightweight high fidelity pickup more than a decade ago.

The "T-Guard" stylus assembly is a quick-change, easy to slip-in unit which eliminates precarious finger-nail fumbling. Its practical "T" shape provides a firm and comfortable grip for safe and easy stylus change.

The most flexible cartridge in the world . . . the FLUXVALVE is the *only* cartridge with the remarkable ½ mil stylus . . . exclusive *only* with PICKERING. The FLUXVALVE can be used with any one of *five* styli, to meet any requirement or application…to play any record, at any speed.

If you are planning to buy a new cartridge—the fact that PICKERING developed this revolutionary stylus is *important to you!* All of the research, development and planning that went into the "T-Guard" stylus is conclusive proof of the superlative engineering skill in every FLUXVALVE model you buy.

Model 194D UNIPOISE Pickup Arm—A new . . . lightweight . . . integrated arm and cartridge assembly containing the FLUXVALVE with exclusive "T-Guard" stylus. The complete assembly – tone arm and cartridge – is only a fraction of the weight of conventional tone arms. The high compliance of the "T-Guard" stylus, with the lightweight tone arm and single friction-free pivot bearing assures distortionless tracking of microgroove and standard groove recordings. Available with the ½, 1 or 2.7 mil diamond stylus, prices from $59.85.

"For those who can hear the difference" **FINE QUALITY HIGH FIDELITY PRODUCTS BY**

PICKERING & COMPANY, INC., Oceanside, N. Y.

NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12 with Preamplifier, Equalizer & Control Section

KIT $34.95 WIRED $57.95

Compact, beautifully packaged & styled. Provides complete "front-end" facilities and true high fidelity performance. Direct tape head & magnetic phono inputs with NARTB (tape) & RIAA (phono) feedback equalizations. 6-tube circuit, dual triode for variable turnover bass & treble feedback-type tone controls. **Output Power:** 12 w cont., 25 w pk. **IM Dist.** (60 & 6000 cps @ 4:1): 1.5% @ 12 w; 0.55% @ 6 w; 0.3% @ 4 w. **Freq. Resp.:** 1 w: ±0.5 db 12 cps – 50 kc; 12 w: ±0.5 db 25 cps – 20 kc. **Harmonic Dist:** 20 cps: 2% @ 4.2 w; ½% @ 2.5 w; 30 cps: 2% @ 11 w; ½% @ 6.3 w; 40 cps: 1% @ 12 w; ½% @ 9.5 w; 2000 cps: ½% @ 12 w; 10 kc: 1% @ 10 w; ½% @ 6 w. **Transient Resp:** excellent square wave reproduction (4 usec rise-time); negligible ringing, rapid settling on 10 kc square wave. **Inverse Feedback:** 20 db. **Stability Margin:** 12 db. **Damping Factor:** above 8, 20 cps – 15 kc. **Speaker Connections:** 4, 8, 16 ohms. **Tone Control Range:** @ 10 kc, ±13 db; @ 50 cps, ±16 db. **Tubes:** 2-ECC83/12AX7, 1-ECC82/12AU7, 2-EL84, 1-EZ81. **Size:** HWD: 3¼" x 12" x 8¼". 13 lbs. Mounts in and out of cabinet.

NEW! 50-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER

HF50 KIT $57.95 WIRED $87.95

Like the HF60 shown below, the HF50 features **virtually absolute stability, flawless transient response** under either resistive or reactive (speaker) load, & **no bounce or flutter** under pulsed conditions. **Extremely high quality output transformer** with extensively interleaved windings, 4, 8, & 16 ohm speaker connections, grain-oriented steel, & fully potted in seamless steel case. Otherwise identical to HF60. **Output Power:** 50 w cont., 100 w pk. **IM Distortion** (60 & 6000 cps @ 4:1): below 1% at 50 w; 0.5% @ 45 w. **Harmonic Dist.:** below 0.5% between 20 cps & 20 kc within 1 db of rated power. **Freq. Resp.** at 1 w: ±0.5 db 6 cps –60 kc; ±0.1 db 15 cps –30 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **All other specs identical to HF60 below.** Matching Cover **E-2 $4.50.**

NEW! 50-WATT Ultra-Linear HIGH-FIDELITY INTEGRATED POWER AMPLIFIER HF52 with Preamplifier, Equalizer & Control Section

KIT $69.95 WIRED $109.95

Combines a power amplifier section **essentially identical to the HF50 power amplifier with a preamp-equalizer control section similar to HF20 below.** Provision for use with electronic crossover network & additional amplifier(s). See HF50 for response & distortion specs; HF60 for square wave response, rise-time, inverse feedback, stability margin, damping factor, speaker connections; HF20 for preamplifier, equalizer & control section description. Hum & noise 60 db below rated output on magnetic phono input (8 mv input for rated output), & 75 db below rated output on high level inputs (0.6 v input for rated output). Matching Cover **E-1 $4.50.**

The specs are the proof... 7 NEW BEST BUYS by EICO®

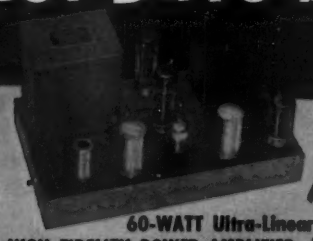
NEW

HIGH FIDELITY PREAMPLIFIER

#HF61A KIT $24.95, WIRED $37.95

with Power Supply: #HF61 KIT $29.95, WIRED $44.95

Will not add distortion or detract from the wide-band or transient response of the finest power amplifiers at any control settings. High quality feedback circuitry throughout plus the most complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece brown enamel steel cabinet for lasting attractive appearance. **Feedback-type, sharp cut-off (12 db/octave) scratch & rumble filters. Low-distortion feedback equalization:** 5 most common recording curves for LPs & 78s including RIAA. **Low-distortion feedback tone controls:** provide large boost or cut in bass or treble with mid-freqs & volume unaffected. **Centralab printed-circuit Sonar "Compentrol" loudness control with concentric level control. 4 hi-level switched inputs** (tuner, tv, tape, aux.) **& 2 low-level inputs** (separate front panel low-level input selector permits concurrent use of changer & turntable). **Proper pick-up loading & attenuation** provided for all quality cartridges. **Hum bal. control.** DC superimposed on filament supply. 4 convenience outlets. **Extremely flat wideband freq. resp.:** ±1 db 9-100,000 cps; ±0.3 db 12-50,000 cps. **Extremely sensitive. Negligible hum, noise, harmonic or IM distortion. Size:** 4-7/8" x 12-3/16" x 4-7/8". 8 lbs.



NEW

60-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER #HF60 with ACRO TO-330 OUTPUT TRANSFORMER

KIT $72.95 WIRED $99.95

Superlative performance, obtained through finest components & circuitry. EF86 low-noise voltage amplifier direct-coupled to 6SN7GTB cathode coupled phase inverter driving a pair of Ultra-Linear connected push-pull EL34 output tubes operated with fixed bias. **Rated power output:** 60 w (130 w peak). **IM Distortion** (60 & 6000 cps at 4:1): less than 1% at 60 w; less than 0.5% at 50 w. **Harmonic Distortion:** less than 0.5% at any freq. between 20 cps & 20 kc within 1 db of 60 w. **Sinusoidal Freq. Resp.:** at 1 w: ±0.5 db 5 cps –100 kc; ±0.1 db 15 cps to 35 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **Square Wave Resp.:** excellent from 20 cps to 25 kc, 5 usec rise-time. **Sensitivity:** 0.55 v for 60 w. **Damping Factor:** 17. **Inverse Feedback:** 21 db. **Stability Margin:** 16 db. **Hum:** 90 db below rated output. **ACRO TO-330 Output Transformer** (fully potted). **Speaker Taps:** 4, 8, 16 ohms. **G234 extra-rugged rectifier** (indirectly-heated cathode eliminates high starting voltage on electrolytics & delays B+ until amplifier tubes warm up). **Input level control.** Panel mount fuse holder. Both **bias** and **DC** — balance adjustments. Sid octal socket provided for pre-amplifier power take-off. **Size:** 7" x 14" x 8". 30 lbs. Matching cover **Model E-3 $4.50.**

NEW

COMPLETE with Preamplifier, Equalizer & Control Section 20-WATT Ultra-Linear Williamson-Type HIGH FIDELITY AMPLIFIER #HF-20

KIT $49.95 WIRED $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. **Rated Power Output:** 20 w (34 w peak). **IM Distortion (60 & 6000 cps/4:1) at rated power:** 1.3%. **Max. Harmonic Distortion between 20 & 20,000 cps at 1 db under rated power:** approx. 1%. **Mid-band Harmonic Distortion at rated power:** 0.3%. **Power Response (20 w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Freq. Resp.** (¼ w): ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps. **5 feedback equalizations** for LPs & 78s. **Low-distortion feedback tone controls:** large boosts or cuts in bass or treble with mid-freqs. & volume unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. **4 hi-level switched inputs:** tuner, tv, tape, aux; **2 low-level inputs** for proper loading with all cartridges. **Hum bal. control.** DC superimposed on filament supply. **Extremely fine output transformer:** interleaved windings, tight coupling, careful balancing, grain-oriented steel. 8¼" x 15" x 10". 24 lbs.
Matching cover **Model E-1, $4.50.**

NEW COMPLETE with FACTORY-BUILT CABINET— 2-WAY HI-FI SPEAKER SYSTEM #HFS1 $39.95

Genuine 2-way book-shelf size speaker system. **Jensen** heavy duty 8" woofer (6.8 oz. magnet) & matching **Jensen** compression-driver exponential horn tweeter with level control. Smooth clean bass & crisp extended highs free of coloration or artificial brilliance. **Factory-built** tuned bass reflex birch hardwood cabinet (not a kit) constructed to high quality standards. Neutral acoustical grille cloth framed by a smooth-sanded solid birch molding. **Freq. Resp.** measured 2 ft. away on principal axis in anechoic chamber with 1 watt input —**Woofer:** ±4 db 80-1800 cps; **Tweeter:** ±2 db 2800-10,000 cps; **Crossover Region:** 1800-2800 cps, shift in level over this region depends on tweeter level control setting. **Power-handling capacity:** 25 watts. **Size:** 23" x 11" x 9". 25 lbs. **Wiring Time:** 15 min.

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for COLOR & Monochrome TV servicing

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shows you HOW TO SAVE 50% on 50 models of top quality professional test equipment.

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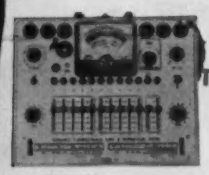


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

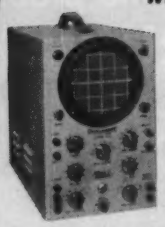
COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication of Gm, Gp & peak emission. Simultaneous sel** of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons: rapid** insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**

NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

Entirely electronic sweep circuit (no mechanical devices) with accurately-biased **incremeter** for excellent linearity. **Extremely flat** RF output: **new AGC circuit** automatically adjusts osc. for max. output on each band with min. ampl. variations. **Exceptional tuning accuracy:** edge-lit hairlines eliminate parallax. **Swept Osc. Range** 3-216 mc in **5 fund. bands. Variable Marker Range** 2-75 mc in **3 fund. bands:** 60-225 mc on harmonic band. **4.5 mc Xtal Marker Osc., xtal supplied.** Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.



NEW! COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95 WIRED $129.50

• Features DC Amplifiers!

Flat from DC-4.5 mc, usable to 10 mc. **VERT. AMPL.:** sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull **thruout;** K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. **SWEEP:** perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); **preset TV V & H positions;** auto. sync. ampl. & lim. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. **6 fund. ranges: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. **Etched tuning dial,** plexiglass windows, **edge-lit hairlines.** Colpitts RF osc. **directly plate-modulated by K-follower** for improved mod. **Variable depth of int. mod. 0-50%** by 400 cps Colpitts osc. **Variable gain ext. amplifier:** only 3.0 v needed for 30% mod. **Turret-mounted coils slug-tuned** for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

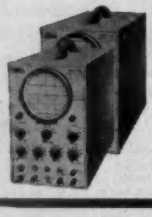
NEW! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

KIT $29.95 WIRED $49.95

Half-turn of probe tip selects DC or AC-Ohms.

Uni-Probe — exclusive with EICO — only 1 probe performs all functions!

Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v with HVP probe & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet.



5" PUSH-PULL OSCILLOSCOPE #425

KIT $44.95 Wired $79.95

7" PUSH-PULL OSCILLOSCOPE #470

KIT $79.95 Wired $129.50

TUBE TESTER #625

KIT $34.95 Wired $49.95

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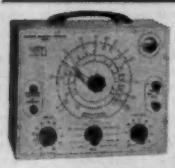

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Electronics on the Hurricane Ship

The R/V "Crawford," 125-feet long and powered by husky twin diesels, carries fifteen officers and crewmen and seven scientists. Formerly a Coast Guard cutter, she is now the property of Woods Hole Oceanographic Institution. Living quarters are forward in hull while the laboratory is at the aft end of the deckhouse.

By
NICHOLAS ROSA
Woods Hole Oceanographic Institution

Special electronic devices provide measurements of the elements on the world's only hurricane vessel, a pioneer in the important science of oceanography.

EVERYONE has at least a nodding acquaintance with the usual items of shipboard electronic gear. Two-way radio in one form or another has been used since the early part of the century and radio direction finders were an early development. Since World War II loran and radar have come into wide use and before that the sonic depth finder, or echo sounder, had appeared.

The world's only hurricane ship, the research vessel "Crawford" of the Woods Hole Oceanographic Institution on Cape Cod, has all of these things, but they are just for getting the ship from one place to another. For her work with the elements, the "Crawford" carries some new developments and others which, if not quite new, are at least exotic.

The "Crawford" is not one of the well-known Coast Guard-Weather Bureau weather patrol ships. She is part of WHOI's private fleet, which includes the famous ketch "Atlantis." Like the "Atlantis," she is essentially an ocean-research vessel. A group of scientists at Woods Hole has developed a theory on the origin of hurricanes in which the moods of the tropical ocean play a major role. None of the other Woods Hole ships was quite suited to the work of investigating this theory, and all were tied to other research programs that have years to run.

Early in 1956, the "Crawford," a surplus Coast Guard cutter in mothballs, was acquired from the U.S. Department of Health, Education, and Welfare. Several months were spent in refitting and alterations, including the addition of a laboratory deckhouse and changes in living arrangements. Air conditioning was installed for cruising in the tropics, something of a novelty on research ships. (Until the "Crawford" came along, it was traditional for oceanographers to steam like so many clams.) Three electric winches, including a heavy trawl winch, were added to the usual deck gear. To power all this, plus an evaporator to make fresh water from the salty, and all the electronic research tools, extra generating capacity was added in the engine room.

In the summer of 1956, the ship was delivered to the WHOI fleet, and after a couple of weeks spent installing research equipment she set out for the tradewind belt of the North Atlantic, the most common breeding-place of hurricanes. Her assignment was not to look for storms but to study the structure of both the atmosphere and the ocean of the tradewind belt. If she happened to be where a hurricane was starting and could get detailed data on the early stages (which has never been done), this would be considered "good luck." The job of "hurricane hunting" is for the B-50's, once the hurricane is big enough to be noticed.

I joined her in San Juan, Puerto Rico, in time to meet Hurricane Betsy, which caught us in San Juan harbor after we had been out for a few days' routine research. The ship was in danger of being pounded against the concrete dock, so we cast off and put out into the wind. The ship handled very well, but we just treaded water until Betsy got by. We had orders not to look for trouble; that was for the hurricane-hunting planes. Betsy was now full-grown; we had missed her birth.

I had been assigned to the "Crawford" to help out with radiosonde observations and also to operate one of the newer "black boxes" in the lab. This was the *conductivity bridge salinometer,* for measuring the salinity of sea water samples.

Salinity can be defined as the total amount, in grams, of dissolved solids in a kilogram of sea water. In all the open oceans and larger seas, where land influences do not interfere, all the solids, or "salts," are in a fixed ratio to each other. Sea water is sea water, whether "thin" like the Baltic Sea or "thick" like the central North Atlantic. The composition is everywhere the same, but the concentration varies. The major salts are ionized; that is, they are broken up into constituent atoms or groups of atoms, each bearing an electric charge. Sea water is an electrolyte.

For that reason, salt water can conduct electricity. Like any conductor, it has the properties of conductivity and resistance, which are functions of each

The author studying the record of the precision echo sounder, which is far more elaborate than conventional sounders and is only partly pictured here. Double row of toggle switches offers wide choice of "ping" lengths and spacings. The parallel lines on paper are fathom-interval marks. Knob near author's wrist controls width of fathom range. Panel marked "Prec." at top has precision a.c. frequency and voltage meters. Outgoing and returning "ping" can be heard through a pair of headphones.

other. It so happens that the conductivity or resistance of a sample of sea water changes predictably with changes in its salinity, "other things being equal."

The most important of the "other things" is temperature. In the salinometer, the sample testing cells sit in an oil bath which is kept at a constant temperature by means of a heating element that is controlled by a thermistor bridge.

In this work, the resistance of the sample has to be measured to the hundredth of an ohm, and a good bridge circuit is called for. An ordinary d.c. Wheatstone bridge would present some problems. Electrolysis effects from the d.c. would damage the sample, with the water breaking up into hydrogen and oxygen, certain ions depositing on the testing cell electrodes, etc.

The Woods Hole bridge, like earlier Coast Guard models, uses a 1000-cycle a.c. signal which keeps these effects to a tiny minimum, which can be ignored.

The sample is connected in the "unknown" arm of the classical bridge circuit. A semi-permanent sample of sea water is carried in an adjacent arm to give both sides of the bridge the same temperature response. The other two arms consist of manual decade resistances. One is the reading arm, which carries a precision potentiometer across part of its circuit for "fine" balancing. The other arm is also variable to compensate for minor variations in the individual testing cells.

Rough balancing is done manually, and then electronics takes over. As long as the bridge is unbalanced, a 1000-cycle signal will appear at its output. The signal is fed to a phase detector (like the one in a modern FM receiver) and compared there to a 1000-cycle reference signal. The output of the phase detector is a d.c. voltage, the polarity of which depends on the direction of unbalance of the bridge.

The d.c. output is fed to a chopper type servo amplifier which controls a small servomotor. This turns the precision potentiometer in the "reading" arm. When the bridge comes into balance, the d.c. voltage disappears, the servo amplifier output cuts off, and the motor stops. A visual indicator geared to the motor-potentiometer shaft reads the final hundredth of an ohm.

The salinometer is checked at intervals against a "standard" sea water carried in sealed glass ampules, and also against standard 500-ohm resistors, which can be substituted for the permanent and "unknown" sea water samples.

Salinity affects the density of sea water, and its boiling and freezing points. It has an effect on the vapor pressure of the water surface, and therefore a slight effect on the rate at which sea water evaporates into the atmosphere, although this last effect is usually masked by other forces.

Salinity is also part of the environment of all sea life, and partly determines what kind of animals can live where in the sea. This is of vast interest to biologists, fisheries experts, and others, including all consumers of sea food, from pelican to epicure.

By plotting the temperature-salinity curves of water samples, oceanographers can trace water from the Mediterranean all the way over to the western Atlantic, and find Antarctic water flowing under the North Atlantic. *Currents* like the Gulf Stream can be traced by salinity as well as temperature contrasts with surrounding waters. Currents carry heat from place to place, it being an old story that the Gulf Stream moderates the climate of Europe. They also carry oxygen, nutrients, and vast streams of plant and animal life in the drifting *plankton*, which is the first link in the food chain running from microscopic algae through shrimp and fish to whales, birds, and men.

I have mentioned temperatures as the other identifying mark of a water mass (such as Mediterranean) or a current. It also happens to be a villain in the hurricane story, because water temperatures down to a considerable depth affect the amount of energy (in the form of heat) available for the making of hurricanes.

Liquid-in-glass thermometers of various types have served very well in oceanography as everywhere else, but they are fragile and fussy. They cannot be used to give a continuous, automatic record, which is often needed, especially when the temperature profile from the surface to a depth is desired.

For many years oceanographers have used a *mechanical bathythermograph*, or *BT*, which is a small, torpedo-shaped brass "fish." This is lowered into the depths at the end of a cable, and it traces a record of temperature *vs* depth on a small smoked-glass slide in its

Scientist puts finishing touches on some of the lab equipment before a cruise. Objects in rack at right are Nansen bottles with deep-sea thermometer frames, used for capturing water samples at different depths. From Nansen bottles samples are transferred to glass or plastic storage bottles which are shown at lower right.

innards. The *BT* is the *sine quâ non* of modern ocean research. It is almost hard to imagine an oceanographic ship moving from one dock to another without starting a *BT* schedule as a regular procedure.

Unfortunately, the *BT*, while rugged-looking and heavy, is vulnerable to thermal as well as to severe physical shock, and is only good to 900 feet. It doesn't take much imagination to know that all kinds of things can happen to smoked glass slides as well, including being smudged by the operator's thumb or dropped to the deck and smashed. If a cable breaks or a fitting comes loose in spite of the operator's loving care, more than just a record is lost in the deep. The brass "fish" itself is quite expensive.

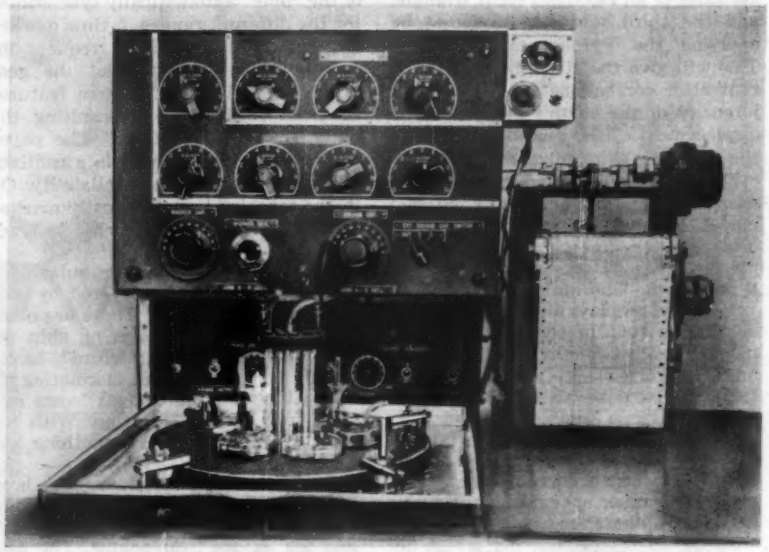
A group of engineers and technicians at Woods Hole have come up with a *thermistor BT*. Variations in the thermistor's resistance with varying water temperature will cause corresponding variations in a current sent through it from the ship. This eliminates the delicate glass slides, as the variations can be recorded on a moving-paper chart. This also delivers a record many times the postage-stamp size of the slide. The record is instantly available and a choice of multiplier resistors and chart speeds control the sensitivity. The thermistor must be electrically insulated and protected from the salt water and its pressure, of course.

Troubleshooting is fairly easy; the equipment is amenable to all the standard servicing instruments. Comparison resistors switched into the thermistor line give spot-checks on calibration. (Checking the calibration of a mechanical *BT* is a long and tedious process.) Taking the surface temperature at intervals with a good liquid-in-glass thermometer and knowing that the machine is properly calibrated are all the oceanographer needs for confidence.

It is still necessary to know the *depth* at which the temperature is being taken. The length of "wire out" will not give the answer because of the movement of the ship. There is always a "wire angle" and this is not constant under water. A combination of a Bourdon tube, sensitive to pressure, and a variable precision resistor is the answer to this.

The thermistor comes into play again for the continuous recording of surface temperatures as the ship cruises. The usual engine-room thermograph (at the cooling system intake) is not very reliable. A thermistor thermograph can be kept "on the nose" very easily. The "Crawford" carries two thermistors in protective housings below the water line on her bow. Either of these may be switched into a recorder in the lab.

For many purposes, the plotting of ocean currents on charts by means of temperature and salinity data is too slow and cumbersome. Sometimes an ocean current will shift, or throw off short-lived "coils" or "eddies."



The front panel of the conductivity bridge salinometer. Moving chart at right records final .01 ohm of reading: hundreds, tens, and units are read from three manual decades at top right. Other five decade switches are for compensating for differences in the five sample cells set in plastic discs (bottom). The magic eye tube shown at the top right of the panel is also used to indicate bridge balance.

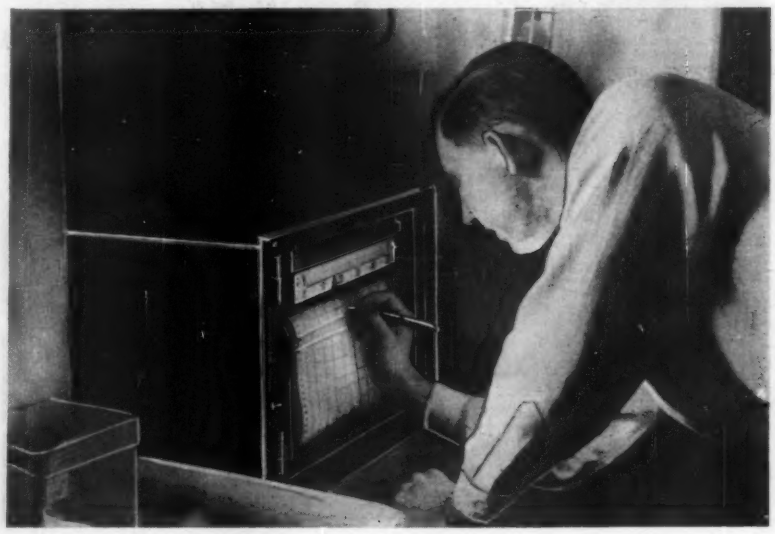
There is another, more direct way of tracing currents in the open ocean, while the ship is cruising in the current. This is the *Geomagnetic Electrokinetograph*, or (understandably) *GEK*.

"Everyone" knows that a conductor moving through a magnetic field will have an electric current induced in it by that field. Sea water is a conductor, and an ocean current is a conductor in motion. The earth itself supplies the magnetic field. The principle of the *GEK* is as simple as that.

The ship trails two electrodes astern, about a hundred meters apart on the same two-conductor cable. They trail far enough back to get away from the magnetic influences of the ship itself. Since the two electrodes are "tapped" along the semi-resistive conductor of sea water, there is a potential difference between them. The *GEK* turns out to be nothing more or less than a recording voltmeter.

After running four minutes on a base course, the ship turns 90 degrees and runs four minutes more. Then it backtracks over both of these legs. This reverses the polarity of the voltages being recorded and allows a "zero point" or average to be taken. Since the current is moving the ship, the "set" of the ship will show up as a displacement of the trace to one side or the other of the zero line. The two four-minute legs

A technician records date and time on the automatic record chart of the Eppley pyrheliometer, used for measuring the intensity and duration of sunlight. This record is similar in appearance to that made on other units used in the laboratory.



are sides of an electrical right triangle, and the third side can be found by applying the Pythagorean Theorem. This will give the strength of the current after corrections for the vertical intensity of the earth's field, etc. The displacement of the recorded legs with the set of the ship indicates direction.

For years sonic sounders have been used in navigation, and a conventional model is used on the "Crawford's" bridge. A very fine version, called simply the *precision echo sounder* or *PES,* is part of the laboratory.

The *PES* employs an *Alden* recorder, in which a strip of chemically treated paper runs between a fixed electrode and a single turn, rotating helix electrode. A current between these electrodes makes a tiny colored mark on the paper. Each time an echo returns from the bottom (or from the scattering layer) such a current flows. Just where the mark appears on the paper depends on where the helix is in contact with the fixed electrode bar which depends, in turn, on the elapsed time since the outgoing "ping" was sent. Paper speed and helix rotation are synchronized so that the fine marks are very close together, making a fairly thick but clean (and clearly readable) line.

A precision a.c. supply is incorporated in the unit to insure proper synchronization. This is a husky amplifier using push-pull 807's in the output. The input signal is supplied by an electrically driven, 60-cycle tuning fork in association with a tube. The input circuit is reminiscent of a crystal r.f. oscillator, except that the tuning fork with its magnetic pickup replaces the crystal in its capacitor holder.

The *PES* gives a breathtakingly clear picture of bottom contours, and the operator may select from several ranges at will to bring out fine detail. The paper speed, helix rotation, and timing of the "ping" automatically synchronize for the different ranges. A time marker appears on the paper at frequent intervals. This helps to plot the geographical positions of bottom features to close accuracy, by consulting the navigator's log of "fixes." The paper comes off the instrument in a continuous sheet for constant availability. On it, the machine has electrically marked fathom-interval lines for ease in reading.

On other ships, enormous submarine canyons have been discovered by continuous echo sounding. These are often named after the discovering ship. At this writing, the "Crawford" hasn't found hers, but it is fascinating to watch the mountain ranges "come into view" far beneath the ship. With the *PES,* cruising becomes something like flying.

The oceans and the atmosphere have long been regarded as heat engines, and modern oceanographers tend to see air and sea as *one* heat engine. The fuel, of course, is the sun, and scientists would naturally want to measure the "fuel intake."

For this purpose the "Crawford" carries a recording *Eppley* pyrheliometer, supplied by the U. S. Weather Bureau. This consists of a sensing element, an amplifier, and a recording output meter. The sensing element is a thermopile mounted between two small discs, a white reflecting disc and a black absorbing disc. This assembly is enclosed in a glass bulb about the size and shape of a 100-watt household lamp bulb. Sunlight produces a temperature difference between the white and black discs. The temperature difference acts on the thermopile to produce a voltage which can be measured and recorded by the rest of the system. The sensing bulb sits high in the rigging and the recorder down in the lab.

Radiosonde was mentioned near the beginning of this article, and now it rounds out the description of the ship's instruments. Most readers are probably familiar with the radiosonde concept, but perhaps a brief review would be helpful.

A balloon is sent aloft carrying weather instruments and a radio transmitter. The instruments are an aneroid barometer, a thermistor temperature element, and a chemical-on-glass humidity strip. The resistances of the latter two change with temperature and relative humidity.

As the balloon rises, the barometer element reacts to the falling air pressure around it. Instead of moving a pointer on a dial face, it moves a contact arm over a printed-circuit switch. With the help of a small relay this switch cuts the instruments in and out of the modulator circuit of the transmitter.

On every fifth contact, a fixed resistor is in the circuit to signal a pressure reference. On all other contacts the humidity element is in the circuit. Between contacts, the thermistor is in the circuit. The resistance of each of these elements, in turn, controls the pitch of an audio oscillator, which modulates the 403-mc. signal of the tiny transmitter.

The receiver on the ground consists of a superhet, an audio frequency meter and still another moving paper recorder. Several manufacturers make the various units of the system. The operator interprets the frequency record to prepare a chart showing pressure, temperature, and relative humidity *vs* height. The results are coded and sent to the Weather Bureau by radio.

Radiosondes were used twice a day during the hurricane-season cruises (summer and fall) of the "Crawford" and surface weather observations were radioed to the Bureau every three hours. The ship thus acted as an "operational" weather station for forecasting purposes, as well as an observatory for the hurricane research program.

At times the "Crawford" has worked closely with the WHOI flying laboratory, a PBY-6. One of the Woods Hole devices aboard the PBY is a radiometer for measuring sea-surface temperatures from altitudes of a thousand feet or so. The "Crawford's" role was to take surface temperatures by conventional means for calibrating the radiometer, plus surface weather observations to supplement the plane's studies of the structure of the tradewind belt.

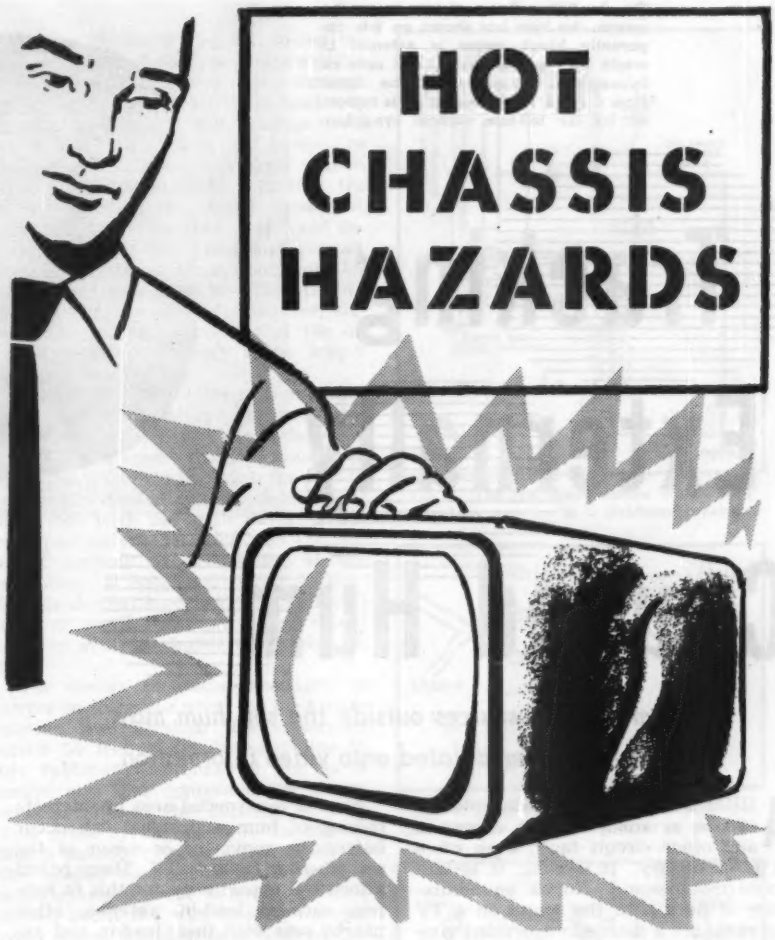
Recently the radiometer has been able to help unravel some of the intricacies of the Gulf Stream's structure. It is now being used in the hurricane studies, along with other special electronic equipment designed for airborne oceanography.

The story of electronics in oceanography does not end here. Many other devices, some just now a-borning, were not carried on the "Crawford" or the PBY for the hurricane work. There

(*Continued on page* 160)

After a cruise come weeks or months of "working up" data. Colin Macafee, expedition leader of 1956 cruises, goes over scientific logs of ocean "stations," where ship stopped to collect hydrographic and meteorological data, with assistant.

HOT CHASSIS HAZARDS



The technician's role is important in keeping transformerless sets and metal cabinets safe.

SOME TWO MONTHS ago, a young boy reached into the metal drawer of a kitchen cabinet to get a knife. Part of his body was in contact with the metal cabinet of a portable-type TV receiver. A moment later, he fell to the floor. Rushed to a hospital, he could not be revived. The wave of comment and reaction touched off by this rare case of electrocution involving a TV receiver has not yet died down.

Before adding to the clamor over the electrical hazards of certain TV receiver designs, we would like to point out one fact: this incident is the second of its kind to gain widespread attention since the rise of TV. Other TV accidents are on record, but they differ in that the individuals involved brushed aside clear-cut warnings to venture unqualified into the interiors of their receivers. Any electrically powered appliance involves some risk. As it happens, the safety record of TV is outstandingly good. Radios, vacuum cleaners, ordinary lighting fixtures, refrigerators, fans, and any number of other home appliances have been involved in accidents at one time or another.

Having said this much, let us also say that we are opposed to corner-cutting in design or manufacture that results in any avoidable risk to life or safety. The manufacturer has a great moral responsibility in this regard, if not a legal one. In fact, the service technician is similarly obligated to his customer, the set owner. His responsibility is particularly great now that some sets are designed so that, although safe initially, changes that can go unnoticed during servicing may turn them into death traps.

The preservation of whatever safeguards are already incorporated in any set is a must, of course. The technician can also function intelligently to introduce safeguards against already existing hazards. After all, once danger exists, it is more important to remove it than to speculate over who must take the blame for its being there.

The problem begins with the practice, adopted widely in recent years, of using dry-disc rectifiers in voltage-doubler configurations to obtain the elevated "B+" voltages generally required in TV receivers. With this technique, a transformer is no longer needed to provide the desired step-up in voltage and, with the elimination of the transformer, a reliable means of isolation from the external source of power is lost. This means that, with the receiver plugged into an a.c. source and the power switch on, one side of the a.c. line may be directly connected to the chassis. If the "hot" side of the line is the one that happens to be connected to the chassis, then full line voltage is available between the chassis itself and such items as radiators, metal portions of plumbing fixtures, or any other grounded objects.

While this practice introduces some possibility of shock, the risk is no greater than that which exists with any conventional a.c.-d.c. radio. However, the use of metal cabinets in conjunction with chassis that may be "hot" increases the risk.

In all cases, there are two general areas in which the technician may function to cut down danger: one is in his own shop, the other is in the home of the set owner. Within his own shop, he must learn to be on the alert for every possible risk of electrical shock that may be encountered in modern receivers and to have a good knowledge of all the built-in precautions taken against this hazard. Jokes are sometimes made about small hardware that is not replaced when a repaired receiver is restored to service. With a potentially "hot" chassis, the matter becomes deadly serious—literally deadly. Failure to restore a single washer may turn a set into a death trap.

Instead of using a single chassis plate, many transformerless TV sets use an isolated subchassis for any components or adjustments that are likely to come into contact with people. Grommets of some insulating material like rubber, fiber, or plastic may be used to isolate such a subchassis from the main chassis. Mounted on this subassembly one may find such components as controls used for regular or occasional adjustment. When such a receiver is re-assembled after repair, it is of the greatest importance that all washers, grommets, separating boards, or other such insulating devices be put back into the set, and that they be re-installed properly.

On some receivers, externally available controls may not themselves be isolated from the chassis, but the manufacturer is careful to provide these controls with shafts made out of non-conductive material rather than the usual metal. If the technician, in the course of servicing such a component, finds it necessary to make replacement, he must always be certain that the substitute part is equally safe. Putting in an otherwise identical control that has a metal shaft, just because it happens to be more conveniently available, may mean poking

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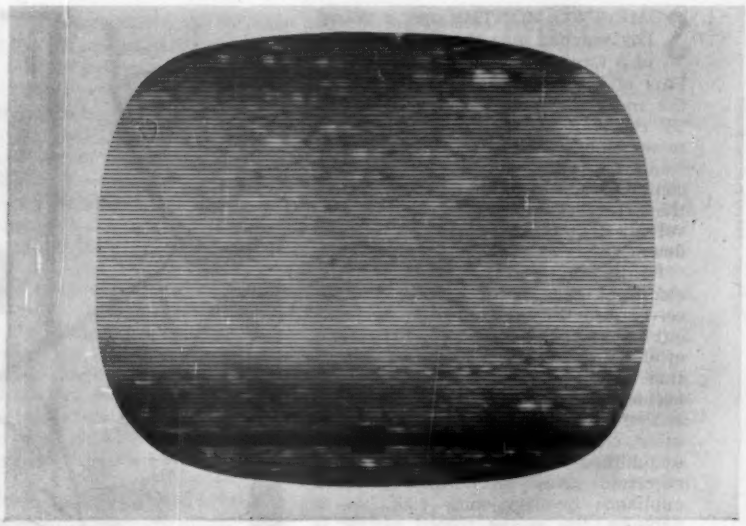


Fig. 1. Although no picture is on the screen, the hum bar shown on this apparently blank raster is external in origin and is being modulated onto r.f. information. Presence of the latter from a weak DX transmission is indicated by the tell-tale vertical sync bar.

Tracking Externally Caused Hum

From bizarre sources outside the set, hum may enter and be modulated onto video information.

By
JAMES A. McROBERTS

A HUM BAR on a television picture can be as annoying to a viewer as any other circuit fault, even when it is stationary. If moving, it is still more troublesome. Nor is an admixture of hum with the sound on a TV or radio set a desirable operating condition. Hum modulation can produce the annoying symptom on either picture or sound, or both. AM and FM radio sets can also suffer from these symptoms.

Although external causes of hum modulation are the primary concern here, it is useful to recall how these symptoms may be produced within the set. The most common cause is a partial short-circuit between the heater and cathode of a tube, as shown in Fig. 2B. Heater current (60-cycle) flows through the same resistance as the signal current, as represented in Fig. 2A. The result is a mixture, although no modulation takes place. Now if this mixture of the two is fed to the detector, one signal will modulate the other, resulting in a signal modulated by the power-line current, or hum.

As Fig. 2B indicates, the actual modulation takes place following the mixing of the signals—in the tuner mixer or converter, or in the second detector (video detector in a TV set). The mixing may take place in the r.f. stage, prior to it, or in the i.f. section. If it occurs in the i.f. strip, then modulation would naturally not be effected until the video detector. As Fig. 2B indicates, modulation at either point can produce the same symptom, which is cured by tube substitution.

Now to our special area of interest: mixing of hum and signal can occur *before* the converter or mixer of the set, whether radio or TV. Many points afford the opportunity for this to happen, such as lead-in, antenna, other nearby sets with their lead-in and antenna systems, power-line leaks, and even the station transmitting the program. Rule out any prolonged station difficulty. Station engineers monitor their programs constantly and repair any defect rapidly at this stage of the art. Hold off for an hour or so on any case of hum modulation that occurs on one station only—you may have a hard time collecting for a hasty call.

Many cases of hum modulation are intermittent. Enlist the aid of the set owner to find out just when the symptom develops so as to be on hand at the right time, rather than when everything is in order. Also have the owner do a little "free diagnosis" when the symptom does arise. Have him switch to a blank channel. If the hum disappears, then it is hum modulation and you can come prepared to cope with it. If the symptom remains unaltered, then a "garden variety" of hum is indicated. A blank channel, by the way, must be *completely* blank. Fig. 1 illustrates a channel without a local station, but with the sync bar of a DX television station present. Note the hum bar varying in intensity from black at the top to a whiter middle, then black at the bottom again. On another *absolutely blank* channel the hum bar disappeared in this particular set.

Caution your customer or recall this tip yourself on a "blank" local channel! By this method you differentiate between hum inside the set not due to modulation and that due to modulation, whatever and however caused. Come prepared with tubes for substitution—and also the equipment later described if you are to track down external hum modulation.

Most cases are intermittent, so find out from your customer whether the hum modulation symptom occurs on a wet day, after a heavy rainstorm, on a humid day, or during any other unusual weather, and also the time of day. The case histories following will give an idea of why this information is important, and also will demonstrate the method of attack on hum modulation external to the set.

Case 1: Here the customer was used as a "free technician" to a considerable degree. The symptom developed after a rain and would slowly disappear. The set owner was loaned an indoor antenna with leads and was shown how to "play detective" by hooking it up to her set. A store set with similar antenna terminal placement was used to demonstrate the test. The elderly lady customer reported back that the hum vanished when the indoor "rabbit ears" was hooked up. The technician thus went out knowing he had a case of hum modulation *not* due to any malfunction of the TV set.

The downpour had stopped when the technician arrived. He reconnected the antenna after verification of his "helper's" story. Then he took the indoor antenna to the roof, substituted it for the outside dipole array, and returned to the living room. The hum bar had returned, along with hum in the sound

background. The trouble was thus localized to the lead-in system.

Opening the window, he saw a lightning arrester. When its ground wire was disconnected, the hum bar and sound symptom disappeared. He cleaned the arrester of accumulated grime and replaced the ground wire. No symptom was present. Then the indoor antenna was removed, the antenna on the roof reconnected, the fee collected, and the technician went on to the next job.

This case is instructive in that we can trace the development of hum modulation from it. Accumulated foreign matter formed paths of leakage resistance (see Fig. 3) between the gaps of the arrester when the latter was wet. The paths dried slowly after the rain had passed, restoring the arrester gaps to the desired open-circuit condition. Since signal is always present along the transmission line, it flowed from this lead-in across the gaps when they were wet enough to permit leakage. Household a.c. current also travelled through the leakage paths. One side of the power line is connected to the pan of the power-company meter, which is effectively earth ground.

Current from the "hot" side of the power line passed through C_1, the line filter capacitor in the set, through the receiver's conductive chassis, to the antenna-input coil, and then to the transmission line. From here, it went through the leakage paths in the arrester and returned through the earth ground of the arrester, which is essentially the same point as meter-pan ground to which the "cold" side of the power line was connected. In effect, both signal voltage and a.c. hum were simultaneously present across the leakage resistance and were thus mixed in the antenna system. Actual modulation did not occur until the mixer or 1st detector in the tuner.

If the service technician had had any doubts about the external causation of the symptom, he could have inserted capacitors C_2 and C_3 in each side of the line. These small units (about 100 $\mu\mu$fd. each) would pass r.f. nicely but would greatly reduce the available power-line voltage across the temporary leaks on the arrester. A pair of such capacitors is handy on hum-modulation symptoms for this test.

That the power line was involved could be ascertained by reversing the power plug: less hum voltage, if any, would then be noted.

Case 2: This history differed from the preceding one in that the symptom disappeared with the indoor antenna connected on the roof. Moving this antenna about could not induce the symptom. (The reasons for probing, or moving the antenna about, will be discussed later.) The original antenna appeared to be at fault.

The driven element of the regular antenna was a folded dipole, mounted on a metal boom which was connected to the mast, as shown in Fig. 4. Electrically insulating this dipole from the boom, as shown in Fig. 4B, solved the problem. The metal mast was making contact with a gutter pipe, through which a return to earth ground was provided. Through this leakage path (Fig. 4A), both signal and power-line voltages travelled. At a hasty glance, one might consider the fact that the center point of the dipole is neutral, and that therefore no signal could develop between that point and ground. However, this condition holds only for that exact frequency to which the dipole is cut. At other frequencies, signal voltage will be present at the dipole's mid-point, which is no longer an electrical center.

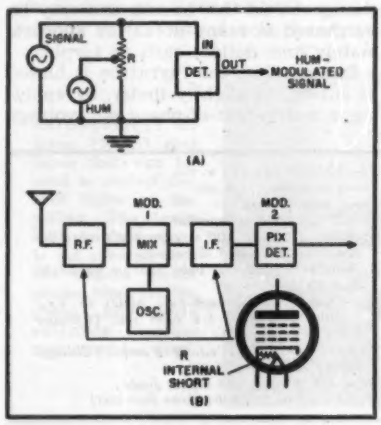
Case 3: More complicated than either of the examples already given is this last, strange history. Before the service call was made, the set owner was once more used to establish the fact of externally caused hum modulation, as described with the other cases. What was particularly puzzling was the unusual pattern of occurrence of the symptom. It happened regularly during the day, with occasional manifestation at night. The symptom would crop up at times during the weekends, too.

The service technician managed to arrive on the scene when the hum modulation was present. He connected about 50 feet of transmission line to his rabbit-ear antenna to act as a probe, and then connected the transmission line to the existing system. This probe arrangement is the one to which passing reference was made in the second case history. With this non-stationary probe antenna, he then moved about the roof looking for one point where the pick-up of hum modulation was strongest. In this way, he found the interference to be originating from a neighbor's antenna.

No, he didn't have any trouble with interference, the neighbor reported when questioned by the technician. Also, he had no objections to letting the technician take a look at his set. Removal of a ground wire from the neighbor's set, with his consent, eliminated the trouble from both receivers.

The reason for this rather strange

Fig. 2. Ways in which hum may enter and be modulated on the signal. See text.



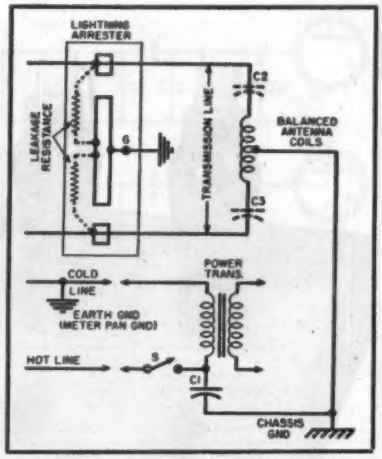


Fig. 3. The resistance across which hum develops may be in a lightning arrester.

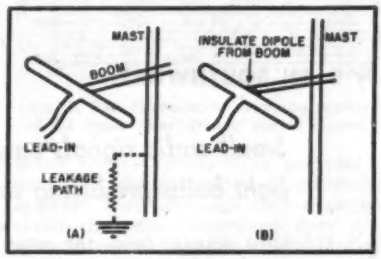


Fig. 4. The mixing resistance may be the leakage path from a mast to ground.

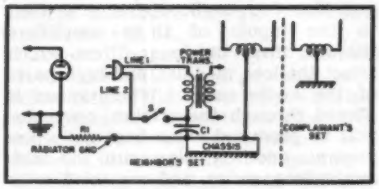


Fig. 5. The neighbor's set, turned off, produced hum in complainant's receiver.

case can be deduced by examining Fig. 5. The ground wire from the interfering receiver ran to a radiator (at the left in the illustration). Between this presumed ground point and the true earth (or meter-pan) ground to which the cold side of the a.c. line was connected, there was considerable resistance. This quantity has been labelled R_1. With the electric plug inserted as shown—and with switch S on the neighbor's receiver in the "off" position—voltage from the "hot" side of the power line went along line 1, through the primary of the set's power transformer, through the filter capacitor C_1, and then, *via* the chassis, up through the center tap of the antenna input coil into the antenna system. From this point it was introduced into the other adjacent antenna.

With the neighbor's receiver switch off, there was virtually no flow of current through the primary of his power transformer, thus practically no voltage drop. At this time, almost the full

(*Continued on page* 176)

Control unit for 3-channel color organ.

Medium Power COLOR Organ

By **GLEN SOUTHWORTH**

Small audio signals easily drive three 100-watt light bulbs producing sound-synchronized colors.

IN ITS most popular form, the color organ consists of three amplifiers, each coupled to a light producing one of the primary colors: red, green, and blue. An audio signal is applied to the inputs of these amplifiers through three bandpass filters which select the low, medium, and high parts of the audio range. When music is played through the system, one color will be produced when bass notes are present, another color with the mid-range frequencies, and the third color when treble passages occur.

The idea of synchronizing colored light with sound has intrigued many persons over a period of several decades and dozens of variations of this technique have been tried out, including some unusual and elaborate public displays. Probably the main reason that the color organ did not find wide acceptance in the home is the fact that most of the early versions used small audio amplifiers capable of generating only about four to ten watts each and, in turn, used this energy to excite pilot lamps or other low wattage bulbs. Of course, the quality of the amplifiers used need not be too good, but still this is an expensive arrangement that tends to be ultimately disappointing simply because not enough light output is available to match the corresponding volume issuing from the loudspeakers. This is true even with 20-30 watt amplifiers.

The objections of low power and high expense are easily overcome by using thyratrons to control the flow of 60-cycle current through conventional 117-volt tungsten lights. The inherent simplicity of this technique is shown in Fig. 1, which diagrams a method of controlling up to one-hundred watts of a.c. power from the output of any conventional, small or medium power, audio amplifier. The thyratron tube used in the circuit can be either an FG-17 (5557) mercury vapor type, or a 3C23, mixed gas tube which has slightly higher ratings. Both tubes are interchangeable in this circuit, and may be purchased in many areas for approximately four dollars each as surplus.

In operation, the thyratron is biased to cut-off, or slightly under, by applying a nearly out-of-phase *a.c.* voltage to the grid. A one-megohm potentiometer acts as a bias setting control, while a one-megohm fixed resistor and a .01 μfd. capacitor in the grid circuit act to provide a moderate amount of phase shift at 60 cycles. This is necessary in order to provide smooth, continuously variable control of the plate current of the thyratron. Now if this phase shift is not present, the tube will tend to act like a relay, firing at a predetermined point. It will be noticed that the out-of-phase grid bias voltage is obtained in a rather unconventional, though economical, manner by using only one half of the winding of a 6.3 volt filament transformer to heat the thyratron cathode, and employing the other half to produce the bias voltage. With the filament transformer used, as a result of the heavy load provided by the thyratron filament, the voltage across the filament came very close to the required two-and-one-half volt value, and the current consumed is well within the rating of the transformer.[1] It is important that the grid bias be in the proper phase relationship with the thyratron plate supply, and it may be necessary to reverse the primary leads of the filament transformer if the bias pot does not control the tube plate current smoothly.

Preceding the grid of the thyratron is a crystal diode which generates a positive d.c. voltage from the output of a simple audio bandpass filter, reducing the effective grid bias and causing the thyratron to conduct in accordance with program content. A small output transformer, connected backwards, acts to isolate the color organ from the audio power amplifier and to step up the relatively small

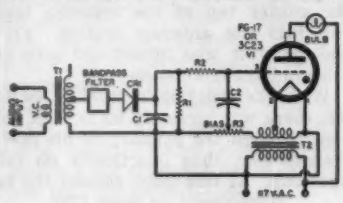


Fig. 1. Schematic diagram and parts list for one of the three channels of organ.

R_1—500,000 ohm, ½ w. res.
R_2—1 megohm, ½ w. res.
R_3—1 megohm pot
C_1—.1 μfd., 200 v. capacitor
C_2—.005-.01 μfd., 200 v. capacitor (value depends on individual thyratron)
Bulb—25- to 100-watt baby spot or floodlight (see text)
T_1—Output trans., push-pull plates to v.c.; 50,000 ohm pri., 3-6 ohm sec. (Chicago RO-113 or equiv.)
T_2—Fil. trans., 6.3 v. c.t. @ 3 amps. (Chicago FO-63 or equiv.)
CR_1—CK705 or 1N66 crystal diode
V_1—FG-17 or 3C23 thyratron (see text)

[1] If it is intended to operate over an extended period, a heavy duty, 2.5-volt filament transformer should be used. The 6.3-volt transformer is then used only for bias.

voltage appearing across the loudspeaker voice coil. The isolation is especially important in reducing the possibility of shock or short circuits inasmuch as the color organ is connected directly to the a.c. line.

The "load" of the thyratron is simply a standard, 117 volt light bulb of between 25- and 100-watt rating. The static brilliance of the lamp may be set by means of the bias potentiometer and the full range between extinction and nearly maximum brilliance should be obtainable by this means. It should be noted, however, that the same intensity as when the bulb is placed directly in an a.c. socket is not obtainable for two reasons. First is the fact a small voltage drop exists in the thyratron tube itself even under conditions of maximum conductivity. Second, and more important, is the fact that the thyratron is actually a grid-controlled rectifier, and consequently only applies alternate half cycles of a.c. energy to the load. These deficiencies can be overcome by using higher plate and bias voltages, but as it was the intent of the author to develop as simple, inexpensive, and compact a circuit as possible, these possibilities were not explored, since they would normally involve the use of heavy, high-wattage, plate transformers.

The choice of light bulbs for a load is influenced by several factors. Clear glass, with the addition of a color filter, seems the most desirable from the standpoint of maximum light output, and the baby spot or floodlight type of lamp is very convenient to use. The small, 75-watt, *G-E* reflector spots are the writer's current choice and provide adequate light output for a medium sized room, good directivity of light pattern, and a relatively small area over which the color filter need be applied. These spots are also available with colored face plates so that external filters may be dispensed with.

Whether several small bulbs are used per channel, or one large one, will affect not only the spatial dispersion of the light, but the dynamic characteristics of the system as well. This is due to the fact that the filaments of the larger bulbs possess more thermal inertia and, as a consequence, are slower to heat up and take longer to cool down than the smaller wattages. In one sense, this is an advantage in that the bigger bulbs produce a smoother changing pattern of light, relatively free from annoying flicker. On the other hand, the transient response of the color organ will be poorer and the instantaneous load on the thyratrons may be appreciably heavier due to the fact that filament resistance is usually much lower when the bulb is cold and higher wattages will cause slower heating.

Fig. 2 shows the input stages for a three-channel color organ. When driven from the voice-coil winding of a conventional audio amplifier the isolation transformer provides adequate response to the inputs of the three audio bandpass filters which cover the range of frequencies shown to the right in Fig. 3. The circuits are of very simple design, and use resistance-capacitance elements for the high-pass and low-pass filters. The mid-frequency range is selected by means of a parallel resonant element, a rather broad peak being obtained in the 1000 cycle region due to the loading effect of the associated resistances.

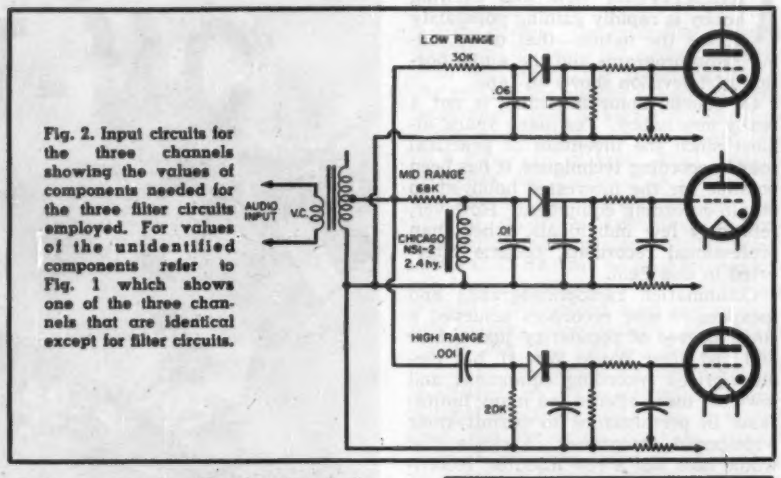


Fig. 2. Input circuits for the three channels showing the values of components needed for the three filter circuits employed. For values of the unidentified components refer to Fig. 1 which shows one of the three channels that are identical except for filter circuits.

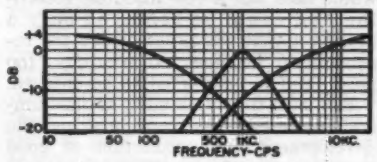


Fig. 3. The approximate response curves of the three filter circuits shown above.

Fig. 3 is the response curves of the three filters shown, but it should be noted that these ranges were selected somewhat arbitrarily and do not necessarily represent the acme of operating practice. The fairly gentle slopes of the filters are rationalized, to some extent, in that they provide less abrupt transitions when instrumental ranges span the area from one filter to another and, although various arguments might be presented regarding steepness of cut-off and other factors, it is a good starting point for the constructor. In fact, if a three- or four-way speaker system were used in conjunction with the color organ, it is quite possible that the bandpass filters shown could be dispensed with altogether, and the various color channels driven directly from the crossover network through small isolation transformers.

The colored filters for the light sources represent another variable in which personal tastes play an important part. Colored cellophane, obtained from a variety store, provides a very inexpensive method of achieving assorted hues, although care must be taken that the cellophane does not come in contact with the bulb, due to the heat produced. You are not bound to use the three primary colors, unless you wish to, and, in fact, you might desire to add more thyratron channels for exotic effects.

Intensity balance between channels seems desirable, however, and some color filters will have appreciably more light loss than others. Similarly, when not glowing at maximum brilliance, a tungsten lamp will produce a distinct yellowish light which will contaminate the color values of some filters during soft passages.

As the color organ is a device intended to produce subjective moods and sensations by synchronizing light to music, its success or failure will depend upon a number of semi-intangibles. Sufficient variety is an important factor, and if you have light colored living room walls an interesting technique is to place the light sources

(*Continued on page* 177)

Arrangement of three 75-watt spot lights that can be used to project colored lights on the ceiling. The lamp bulb in the center is not covered with its colored cellophane filter in this photo. Any other suitable arrangement may be used.

Here are a few important features you should check:

Off-The-Air

By LOUIS E. GARNER, JR.

It's easy to do and it's lots of fun. Remember, too, that in time, many of your recordings will become priceless.

A RELATIVELY new and exciting hobby is rapidly gaining popularity across the nation—that of recording radio programs and the audio portion of television shows on tape.

Of course, home recording is not a really *new* hobby. For many years, almost since the invention of practical sound recording techniques, it has been possible for the interested hobbyist to obtain recording equipment. However, relatively few individuals, other than professional recordists, became interested in this field.

Combination radiophonographs and inexpensive disc recorders achieved a small degree of popularity just before and just after World War II, but medium-priced recording equipment and low-cost discs offered too many limitations in performance to permit their widespread acceptance. A single disc would hold but a few minutes' recording and could be replayed only a limited number of times before the reproduction became too scratchy, too noisy, and too distorted to be enjoyed.

But with the availability of medium- and low-priced tape recorders, and the development and production of good quality magnetic recording tapes, permitting 15 minute, half-hour, and hour programs to be recorded, home recording has really come into its own, with off-the-air recording rapidly becoming one of the predominant areas of home recording activity.

More and more individuals are finding that this interesting hobby offers worthwhile relaxation while enabling them to build valuable sound libraries of good music and entertaining shows.

Nor does this new hobby lack excitement. Many off-the-air recordists are assembling personal libraries of "living history" by recording great political speeches, panel discussions, the accounts of noteworthy achievements in science and sports, and on-the-spot news reports of disasters, revolutions, congressional hearings, meetings of the UN, and other events of worldwide importance.

But, unlike many hobbies, off-the-air recording is much more than a hobby in itself, it can be a valuable adjunct to almost any other hobby and to many businesses. Thus, it offers something for every individual, irrespective of his tastes or interests.

The movie fan can record the annual awarding of the "Oscars," interviews with his favorite motion picture stars or their appearance on panel or discussion type shows, and even the sound track of favorite older movies that are shown on TV.

A sports fan can record play-by-play accounts of outstanding sports commentators and interviews with his favorite players. A fan of a particular baseball team, for example, may want to specialize by recording the play-by-play accounts of all games played by "his" team. Lucky indeed is the baseball fan who had the foresight to record the play-by-play description of the first no-hit, no-run World Series game in the history of modern baseball.

Teenagers, having access to their own tape recorders, may build up complete libraries of recorded performances of their current singing idols.

Parents can record children's shows for playback when their smaller children become old enough to enjoy them or for "rainy day" amusement. Or those children's programs which are broadcast too late in the evening for the smaller children can be recorded and played back during daylight hours. Some parents may wish to record the complete musical scores of outstanding special radio and television programs, such as "Peter Pan," "Jack and the Beanstalk," or "Cinderella."

Arm-chair and barber-shop "politicians" will find that there is no surer way to settle a political argument about "who said what" than by playing back a tape recording of the speech or talk in question.

The true audiophile soon realizes that a tape recorder is an essential part of a complete hi-fi installation. Many amplifier manufacturers, recognizing this fact, have included tape input and output jacks as essential features of their instruments, thus simplifying the task of adding a recorder to a completed installation.

Thus, the audiophile may wish to assemble an extensive tape library to complement his collection of disc recordings.

Many recordists will specialize, building up their tape libraries by recording only classical music, others may prefer a library of popular music or "Hit Parade" songs, others might specialize in calypso, others in jazz or bop, or still others might prefer marches or patriotic music.

A good number of home recordists are interested in building up tape libraries of "mood music," making up their own programs by recording, on a single tape, individual selections from a number of different radio or television programs, until they have a full half-hour or hour tape of "dinner music," "dance music," "gay music," or "relaxing music."

Others, with more catholic tastes, may run the full gamut, recording any- and everything that is of interest: sports events, music, speeches, drama, opera, and even news broadcasts.

But off-the-air recording, quite aside from its great value as an entertaining hobby, can be of real help in business, in the professions, and in the arts.

A business man might wish to record the daily market quotations, talks by business analysts, and important political speeches which might affect his operations. An attorney may find it helpful to record congressional hearings, detailed news accounts of current trials, and similar material. A farmer may wish to keep a day-by-day recording of broadcast weather reports, temperature readings, or market prices on farm produce. A clergyman may record outstanding sermons, helpful talks, different religious services, hymns, or religious dramas.

For the serious student of literature, music, or drama, there are few study aids superior to an off-the-air recording of a modern play, a Greek drama,

an opera, a piece of classical music, or one of Shakespeare's immortal works. Interesting passages can be played over and over as many times as necessary to obtain a clear understanding of the piece. Great operatic arias can be studied in detail. Any questions about actors' lines or the proper treatment of a given scene can be rechecked as often as required.

Legal Aspects

The recording of radio programs for private enjoyment is perfectly allowable but there are stringent laws covering the *reproduction* of copyrighted material. Therefore, anyone planning the commercial use of off-the-air recordings, such as copying for sale or playback before public audiences, should check with the broadcast station or network whose material has been recorded and with the copyright owner in the case of musical compositions, plays, and similar material, prior to using such recordings.

Techniques

Off-the-air recording is a hobby anyone can adopt since it calls for no special skills, training, or physical prowess.

From the financial viewpoint, off-the-air recording has much to recommend it. As far as the initial investment is concerned, the basic equipment needed can be purchased for less than $100.00 if you are on a budget. On the other hand, if you have a "fat" pocket and are in the mood to splurge, you can invest well over a thousand dollars in professional recording equipment and accessories.

The cost of "upkeep" is low. Good quality magnetic recording tape is relatively inexpensive, especially when purchased in quantity lots, since many local distributors and most mail-order jobbers offer special discounts where a half-dozen or a dozen rolls of tape are purchased at one time. Unlike film, there is no "processing cost" to add on to the basic price of the tape. Finally, magnetic recording tape is re-usable. A recorded program can be erased and new material recorded at will.

Basically the only equipment you need is a radio or television receiver (which you probably have), a tape recorder, a connecting cable or two, and a few rolls of magnetic recording tape. Later, as your interest grows and your skill increases, you can add such special accessories as splicing and editing tools, a mixer, a "tape safe," and similar items.

Selecting a Recorder: Chances are that the cost of the tape recorder of your choice will represent the largest single investment in this hobby. Because of this, it is wise to consider this item carefully before making a final decision.

Obtain technical data and catalogue sheets describing the various units and read these carefully. Compare basic electrical specifications and operating features as well as selling prices. Pay particular attention to the specifications and features of units selling in the same approximate price range. While it is axiomatic that any standard brand tape recorder will generally be a "good buy" at its advertised price, it is also true that a difference of just a few dollars in cost will often mean a real difference in performance and in operating convenience.

A good rule to follow is to purchase the *best* recorder you can afford.

Here are a few important features you should check:

Tape Speed: The recording speed is measured in *inches per second.* In general, the higher the recording speed, the greater the quality potential of the recording. But a higher recording speed means that you can record *less* on a given reel of tape. Most modern recorders are designed to operate at two speeds, 3.75 ips and 7.5 ips. For general "off-the-air recording," a *two-speed* machine is preferred. The lower speed (3.75 ips) can be used for recording longer programs where maximum fidelity is not needed, such as speeches, play-by-play descriptions of sports events, etc. The higher speed (7.5 ips) should be used where maximum fidelity is desired, as when recording opera, musical selections, and so on. In either case, the recording *must be played back at the same speed at which it is recorded.*

Reel Capacity: The most popular reel sizes for home recording are 3″, 5″, and 7″ in diameter. Make sure any recorder you select can handle all of these sizes. If it can handle larger reels as well, fine! Smaller "portable" recorders should be able to handle 3″ and 5″ reels with their lids closed. Larger units should be able to handle all three sizes with their lids completely closed.

The reel capacity, tape speed, and type of tape you use will determine the maximum recording time without changing tape. More about selecting tape later.

Using "standard" tape, a 3″ reel will hold 150 feet of tape, giving a recording time of approximately 4 minutes at 7.5 ips or 8 minutes at 3.75 ips. The approximate recording times for different sized reels, using standard tape, are given in Table 1.

Of course, most modern recorders are designed for dual-track recording and playback. The program material is recorded along one edge of the tape. The tape is then reversed and additional material can be recorded along the other edge. This doubles the storage capacity of a given reel of tape. Thus, a 7″ reel (1200 feet) can handle a 1 hour program at 7.5 ips, but it is necessary to remove the reel and reverse the tape at the half-hour "break."

Operating Controls: Before choosing a recorder, make sure that the various operating controls are easy and quick to use. Some brands are equipped with "push-button" controls, others have a single, easy-to-operate control lever. In addition to ease of operation, make sure that the controls are as "foolproof" as possible. It is quite disheartening to accidentally erase an irreplaceable recording. Some recorders are equipped with special locks to prevent accidental erasure of tapes.

All recorders have a level indicator to indicate overload when recording. This may be a small neon bulb which flashes when overload occurs, a "magic eye" type device (similar to the "tuning eyes" on radio receivers), or a meter. A skilled professional recordist

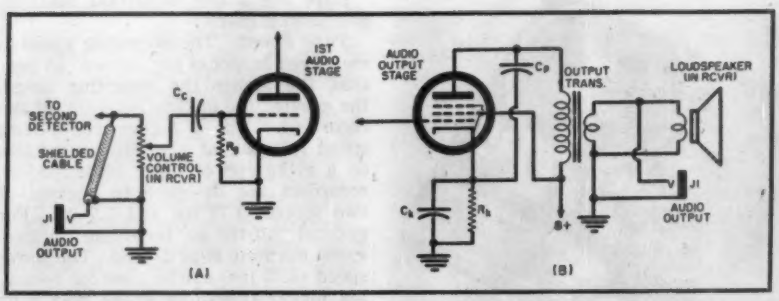


Fig. 1. Two ways of obtaining an audio output signal from radio or TV receiver.

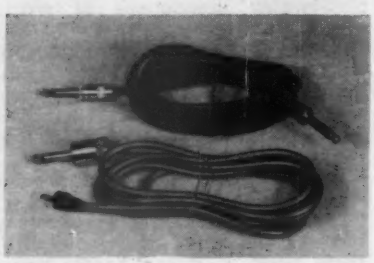


Fig. 2. Typical shielded connecting cables.

will prefer a meter, but a beginner will probably find that a flashing neon bulb or "magic eye" indicator is easier to use.

Since you intend to use the instrument for "off-the-air" recording, make sure the unit is equipped with a tuner input jack. If you already have an older recorder which doesn't have this feature, you can use the mike input jack.

Frequency response: Most low cost tape recorders have a frequency response of from about 60 to 8000 cps when recording at the 7.5 ips speed (the response may be limited to about 6000 cps at 3.75 ips). This is ample for voice and provides satisfactory reproduction of popular music. If you intend to record classical music, operas, and hi-fi program material, however, you'll need an instrument with a response at least 60 to 10,000 cps and, preferably, even better. There are moderately priced instruments available with a response of 30 to 12,000 cps. Of course, high-priced "professional" recording equipment can be purchased with an even better frequency response.

Along with good frequency response, the instrument should have low hum, wow, flutter, and distortion. Wow and flutter should be less than 0.5%. The signal-to-noise ratio should be at least 40 db.

The power output of the instrument is relatively unimportant, especially if you plan to use the recorder in conjunction with an established hi-fi installation. Low cost recorders generally have a 3- to 5-watt system, more expensive units a 5- to 10-watt amplifier.

Basic Recorders: If you'd like to plan a "permanent" installation and already have a hi-fi system (amplifier, loudspeaker, tuner, etc.), you might consider the purchase of a "basic recorder." These are offered by several manufacturers and include the basic tape mechanism and special electronic circuits needed for tape recording. The power amplifier and loudspeaker are omitted.

AM, FM, or TV? Once you are set up for off-the-air recording, you'll have a choice of several sources of material; AM radio, including both the broadcast and short-wave bands (if you have a suitable receiver), FM broadcast band, and the audio portion of TV programs. Often, the desired material will be broadcast in only one of these media. Where this is the case, you have no choice. On the other hand, important political speeches, sports events, and special events coverage may be broadcast on all stations. In such a case you can pick the medium giving the best coverage or reception in your locality.

As a general rule, material received over the FM broadcast band (88-108 mc.) is the best for off-the-air recording from the viewpoint of fidelity and freedom from noise and static. It is almost mandatory for hi-fi recording.

A second choice is the audio portion of TV programs. Broadcast by narrow-band FM, this material may be of somewhat better quality than conventional AM broadcasting as far as fidelity and freedom from noise is concerned, but has one disadvantage. If the audio material relies too much on the picture, an audio recording alone may be unsatisfactory. In the future, however, we may expect to see suitable video tape recorders offered to the general public. Such instruments can record both picture and sound and are now in use by many television studios. Present-day equipment is large and expensive and, therefore, unsuitable for home use.

Finally, the AM broadcast band offers a wide choice of material. Where the spoken word is to be recorded exclusively or where your tape recorder has limited frequency response, the AM band is entirely satisfactory. Typical program material here might include sports events, newscasts, market reports, speeches, radio plays, and similar shows.

If your AM receiver is equipped for short-wave reception, you'll find your tape recorder handy for recording code transmissions (if you are a ham or if you're learning the code) or foreign language broadcasts (if you are studying the language).

Connecting the Recorder: If you have a modern hi-fi installation, it is a cinch to connect your tape recorder for off-the-air recordings. Most modern hi-fi amplifiers are equipped with special "tape recorder" jacks.

You will need a pair of shielded single-conductor cables. See Fig. 2. One end of each cable will be equipped with plugs to fit the "tape record" and "tape playback" jacks of your amplifier. The opposite ends of the cables should be equipped with plugs to fit the tuner input (or microphone input if you don't have a special jack for this in your recorder) and output (or auxiliary speaker) jacks of your recorder, respectively.

If you have a standard radio tuner, simply prepare a shielded single-conductor cable terminated at one end with a plug to match the output jack of your tuner and at the other end with a plug to match the tuner input jack of your recorder.

Finally, if you wish to connect your tape recorder into a standard radio receiver or TV set, you will need to install a special audio output jack on the receiver. Your nearest radio service technician can do this job for you if you prefer not to work on the set yourself. Typical connections are shown in Fig. 1.

You can obtain the audio signal either from across the receiver's volume control, as shown in Fig. 1A, or from the loudspeaker voice coil terminals, as shown in Fig. 1B. In either case, you'll need a shielded single-conductor cable with a plug to match the audio output jack, J_1, to the tuner input jack of your recorder. The "ground side" connects to the outer shielding braid of the connecting cable.

The arrangement shown in Fig. 1A is preferred where the audio system of your receiver is of mediocre quality. With this arrangement, the receiver's volume control will not control the signal supplied to the recorder.

With the arrangement shown in Fig. 1B, the receiver's volume control will affect the output signal level. This arrangement is satisfactory where the receiver incorporates a high quality audio amplifier.

(*Continued on page* 114)

Table 1. Approximate recording and playing times of reels of magnetic tape.

REEL SIZE	"STANDARD TAPE"			TIME AND A HALF "EXTENDED PLAY"			DOUBLE TIME "EXTENDED PLAY"		
	Cap.	3.75 ips	7.5 ips	Cap.	3.75 ips	7.5 ips	Cap.	3.75 ips	7.5 ips
3"	150'	8 min	4 min.	225'	12 min.	6 min.	300'	16 min.	8 min.
4"	300'	16 min.	8 min.	450'	24 min.	12 min.	600'	32 min.	16 min.
5"	600'	32 min.	16 min.	900'	48 min.	24 min.	1200'	1 hour	32 min.
7"	1200'	1 hour	32 min.	1800'	1½ hours	48 min.	2400'	2 hours	1 hour

The times listed are for one side only. Double figure for dual-track recording, but remember tape reel must be reversed.

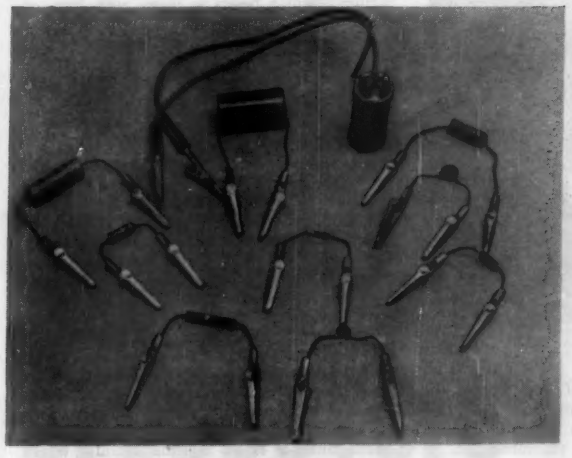


Fig. 1. Common, single-component jigs used in service, referred to in text.

Fig. 2. Clip leads can also be fixed to elaborate components such as potentiometers, i.f. cans, printed circuits. →

Substitution Jigs Speed Service

By B. VAN SUTPHIN

The use of clip leads for temporary test hook-ups can be extended to provide even more time-saving.

IN THE service shop, the accent must be on convenience and speed. If time can be saved, that means more income per hour of work.

Most shops keep a collection of clip leads for temporary connections to speaker voice coils, phono motors, and other points. These are simply lengths of insulated wire with alligator clips at each end. In addition, special jigs are often made up for connection problems that come up again and again. Typical examples are jigs to fit the speaker sockets of popular auto radios with leads to connect to the shop test speaker and special jigs for feeding the sweep-generator output to a TV receiver.

This idea can be extended even further. Fig. 1 shows some single-part jigs convenient in radio and TV servicing. Included are two common filter capacitors, a special-value 1000-volt capacitor for testing in damper circuits, a general-purpose 600-volt test capacitor, two resistors of common value, and three low-value ceramic capacitors for general-purpose testing. Although not shown in Fig. 1, a video-detector diode jig is also convenient. The units shown are constructed by adding alligator clips to each end of the individual parts. For maximum safety, insulated clips can be used if they are available.

With a collection of these aids, part substitution is simply a matter of connecting two clips. This system is much safer than trying to hold a part in place while watching a TV screen and it is much simpler than "tacking" new parts in place with solder. Think of the ease of substituting new parts when the customer asks for a quick estimate!

In most cases, substitution can be made by clipping the replacement directly across the suspected part. Of course, this does not apply when the suspected defect is a short in the original part. In those cases, you would have to disconnect one side of the original part and then clip the new one in place, but even here some time is saved.

As shown in Fig. 2, this idea can be carried further yet. Clips can be mounted on potentiometers, i.f. transformers, and even complete printed circuits, provided there are not too many leads. The "can" shown in Fig. 2 is a 4.5-megacycle sound take-off coil common in many receivers. The printed circuit with three leads is a vertical integrator network, complete with built-in blocking capacitor (*Centralab* PC-101). The blocking capacitor is important so that the network can be used in more receivers—this one can replace the original network whether it uses a blocking capacitor or not, and whether it is a printed circuit or uses separate components.

In Fig. 2, the printed circuit with four leads is a complete network for coupling the plate of a triode audio amplifier to the grid of an output stage.

If a number of these printed-circuit jigs are used, it is a good idea to draw the schematic of each one on heavy paper and then paste it to the side of the printed circuit. Use ink for drawing the schematic, and then coat the drawing with spray plastic to protect it.

The twin-resistor jig at the upper left-hand portion of Fig. 2 is a pair of 100,000-ohm resistors in series. This is for insertion in discriminator or ratio-detector circuits during alignment. This is much simpler than

(*Continued on page* 107)

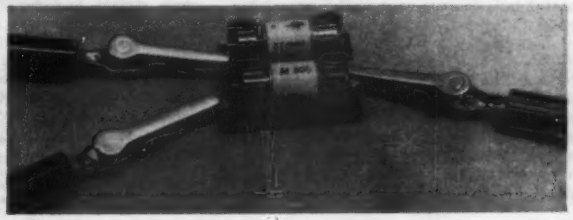


Fig. 3. Two silicon rectifiers in holder can be hooked up in half-wave, full-wave, doubler, or other configurations for power-supply tests.

By BERT WHYTE

WELL, it is October again and in addition to Autumn leaves and nut-brown ale, it is time for the Audio and Hi-Fi shows. Although preceded by the Chicago show, the Institute of High Fidelity Manufacturers' New York Hi-Fi Show is generally regarded as the "kick-off" for the season. It is at the New York Show that the manufacturers put their best foot forward, where they hopefully debut new products and new ideas. Of course, every year things are "bigger and better" and the advance whoopla for the 1957 show indicates that this will indeed be a tremendous affair. There will be more hi-fi products displayed and demonstrated under one roof than at any previous audio show. The New Yorker is the most sophisticated of audiophiles and the uppermost question in his mind will be, "Is there anything that is *really* new?" I venture to predict that there are going to be a number of items that will startle the most blasé afficionados. A good bet is that multiplex stereo FM will at long last make its bow, as well as not one but *several* varieties of monogroove stereo disc. Stereo will, in general, be the central interest in the show with scads of new equipment available for its reproduction.

As always, I look forward to the New York show as it gives me an opportunity of meeting and chatting with many of the readers of this column. If I can be of help to anyone, check on my whereabouts with the RADIO & TV NEWS room.

Plenty of fine stuff this month so here we go!

DVORAK
SYMPHONY #2
Vienna Philharmonic Orchestra conducted by Rafael Kubelik. London LL1606. RIAA curve. Price $3.98.

The third and by far the best version of this little-played but most lovely and melodius symphony. Dvorak's countryman, Kubelik, has a natural affinity for his works and his reading here is exemplary. His approach is lyrical and romantic, but never over-blown. He does not succumb to the opportunity for bombast in this exciting score, but handles the tensions of the work with great good taste.

Soundwise this is one of the best *London* recordings in recent months. The over-all impression is huge . . . a great, broad superresonant sound spiced with sparkling instrumental detail. Strings were well forward, but smooth and superbly balanced. The woodwind had that rich sonority which is characteristic of the Vienna Philharmonic, the brass sound ran the gamut of expression from mellow fullness to sharp punchy brilliance, percussion was exceptional for accuracy and articulation. Frequency and dynamic range were uncommonly wide, no transient distortion nor wow nor flutter were anywhere in evidence, surfaces of my review copy were pleasingly quiet. Those of you who favor the Dvorak 5th symphony will find this work equally exciting from both the musical and sonic aspects. Highly recommended.

SHOSTAKOVICH
SYMPHONY #10
Philharmonia Orchestra conducted by Efrem Kurtz. Victor LM2081. RIAA curve. Price $3.98.

This recording is one of the last fruits of the long association of *RCA* and *HMV*. Presumably *Victor* has a few more *HMV* items it can issue, even though the tie-up ended officially on August 1st. This newest symphony of Shostakovich seems to be more than ordinarily attractive to recording companies since this is the fourth LP version in its relatively brief history. On grounds of performance it lies somewhere between the Mitropoulos and Ancerl recordings. Kurtz imbues the score with a great sense of drama and urgency, perhaps more than the score is capable of sustaining. There is no denying he makes of it an exciting experience. In matters of sound, this is the best of all the versions. The *Columbia* comes closest as competition, but it can't equal the dynamic scope, nor the clean crisp definition afforded by the *HMV* engineers. Particularly striking brass sound here, very weighty and sonorous, and percussion of notable precision and impact. If sound is the major issue with you, this is the obvious choice.

MOZART
EINE KLEINE NACHTMUSIK
SYMPHONY IN C MAJOR ("LINZ")
London Symphony Orchestra conducted by Antal Dorati. Mercury MG50121. RIAA curve. Price $3.98.

This is another of the recordings resulting from *Mercury's* first English trip. Dorati confounds those who carp at his handling of the so-called "standard" repertoire with these superbly realized performances. His Mozart is not "formless and without heart" but rather is a warm and thoroughly ingratiating experience. The outstanding characteristic is his cleanness of line, the crisp economy of his musical means. If this be lack of sentiment I say make the most of it. Here uncluttered and free from obfuscating mannerisms is the most refreshing "Eine Kleine" in the LP catalogue.

The sound abets this viewpoint with ultra-clean strings and dazzling woodwind. This is the Mozart orchestra, close-up in recording, sharply etched in its details, yet with acoustic perspective necessary to allow for a little more expansion than our 15 by 20 living rooms. The London Symphony has never sounded better, and it is a positive joy to savor the richness of its strings. The usual shrillness which besets so many recordings of this work is happily absent. The "Linz" Symphony is treated in equally balanced sound and, all in all, this is one of the most successful Mozart recordings from both the sonic and performance viewpoints.

SAINT-SAENS
CONCERTO #3 FOR VIOLIN AND ORCHESTRA
PAGANINI-KREISLER
CONCERTO FOR VIOLIN AND ORCHESTRA IN ONE MOVEMENT
Campoli, violinist with London Symphony Orchestra conducted by Pierino Gamba. London LL1624. RIAA curve. Price $3.98.

Those of you who enjoy the violin concerto will certainly like this recording. Campoli is a tremendous virtuoso of the bravura school. His tone is broad and rich, his technique facile and assured. He has not the polish and grace of Francescatti in the Saint-Saens but his is an exciting reading which commands unflagging interest. The Kreisler one movement arrangement of the great Paganini concerto may appear to some as a circumvention of the technical difficulties of the other movements of the original concerto, but this has found a legitimate place in the concert repertoire of many violinists. It would certainly be foolish to call it technically simpler! There are the same double stops, harmonic bridging, and other devices of violin gymnastics that arouse our admiration of these great violin artists.

In matters of sound it is strictly no contest in the Saint-Saens. The Francescatti *Columbia* recording was good in its day but it can't hold a candle to this ultra-clean, superbly balanced reading. Campoli's violin is given slight prominence in the over-all sound, and the tonal delineation is outstanding. This is another "big hall" sound that gains in naturalness by a sharp leaven of detail. In the Paganini, the violin is balanced equally with the orchestra, but there is no loss of detail. Again we have exemplary recording somewhat more imposing in sonic weight as compared to the Saint-Saens. Quiet surfaces added still another fillip of realism.

BRITTEN
YOUNG PERSON'S GUIDE TO THE ORCHESTRA
DOHNANYI
VARIATIONS ON A NURSERY TUNE
Concert Arts Symphony Orchestra conducted by Felix Slatkin. Capitol P8373. RIAA curve. Price $3.98.

I can't recommend this recording too highly. It has all the elements that will make it a best seller. The music is among the most charming and delightful ever written, the performances rank among the best available and the sound is sheer magnificence. In the "Young Person's Guide," *Capitol* has outdone the best of their previous efforts in matters of sound. This has everything . . . spacious acoustic perspective, coupled with sharp orchestral detail. Each instrument is brightly limned and yet is an integral part of the body of sound. All elements are crisp and clean, bright, rich, redolent of naturalness.

There are several other excellent versions of the "Guide," but even if you already own one, this is still worth acquiring, if only because the flip side has the saucy and impudent Dohnanyi "Variations." This is really one of the most fantastic little works ever written. Few who have heard it will ever forget the huge pompous bombastic opening, leading finally to the simple and familiar nursery theme statement on the piano. Then Dohnanyi leads you through the doggondest clever set of variations on this theme. Some

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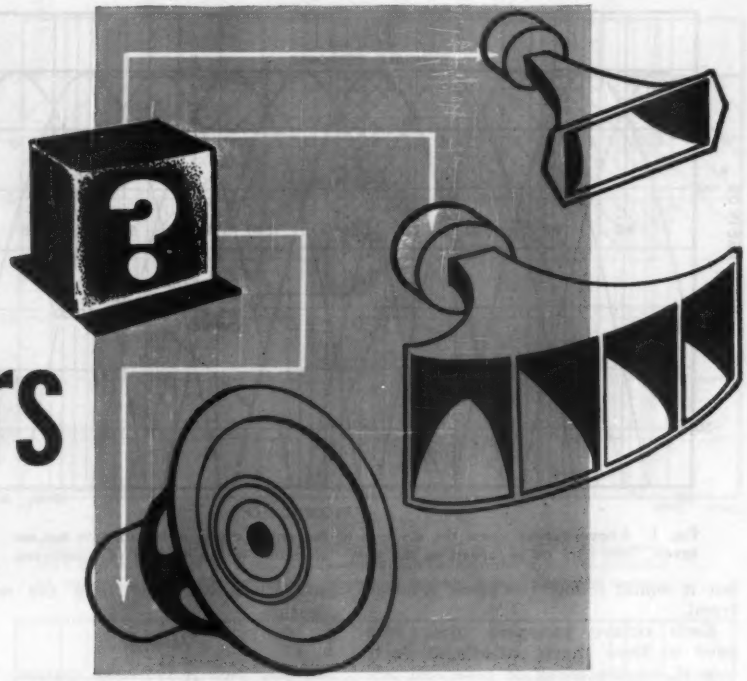
The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

Choosing Your Crossovers



By
NORMAN H. CROWHURST

What crossover frequencies and circuits should you use in your 2-, 3- and 4-way hi-fi speaker systems?

WHEN you set out to choose your hi-fi loudspeaker installation, you probably do not choose the crossovers as a separate entity, it is true. But different systems offer quite a variety of different crossover frequencies and rates of roll-off, etc., so you will want to know what it is that governs this choice. How many crossovers (two-, three- or four-way system), what frequencies are used for crossing over, and how sharply do the crossovers act are questions to which each system gives different answers.

How Many?

On the question of how many crossovers, there are two extreme schools of thought. One of these favors no crossovers at all—a single extended range loudspeaker unit, that responds to all the frequencies in the audio range. According to protagonists for this approach, you will avoid all the phase shifts and all the problems that crossovers "get you into." What you don't avoid, however, is the problem of getting one loudspeaker unit to respond to a frequency range covering the ratio of 1000 to 1, from 20 cycles to 20,000 cycles. Even if you are content with a slightly less ambitious range, say from 40 cycles to 10,000 cycles, this is still a tremendous range of frequencies to cover with one vibrating system.

To radiate the low frequencies satisfactorily, it must inevitably have a large surface area exposed for radiation. To radiate the upper end satisfactorily it must be extremely light and rigid, to avoid the kind of breakup that causes erratic response to consecutive frequencies.

Another requirement is that it shall not introduce any distortion. If there is any distortion in the way it handles the lower frequencies with the large movements they involve, this will also modulate the higher frequencies, besides causing distortion components to the low frequencies themselves. This intermodulation, as it is called, gives a "dithery" rendering of programs when low frequencies and high frequencies occur at the same time, and can be particularly noticeable on material like organ music.

It is practically impossible to make a loudspeaker unit with perfectly uniform response over a range of even 250 to 1 (let alone 1000 to 1) and also with absolutely no distortion, particularly of the lower frequencies. The use of crossovers proves to be a boon in helping out, both to achieve a uniform frequency response and minimize intermodulation distortion. This leaves us with the question, how many crossovers, and where?

Here the protagonists of the opposite extreme come in by pointing out that serious intermodulation distortion can only appear when more than one octave is handled by the same loudspeaker. Consequently it would be good to have 10 loudspeaker units, each covering an octave and thus completing the range from 20 cycles to 20,000 cycles. The first loudspeaker unit would cover from 20 to 40 cycles, the second 40 to 80, the third 80 to 160, the fourth 160 to 320, and so on, up to 20,480 cycles. This would necessitate nine crossovers between the 10 units.

Of course, there is no comparison between the effect of these two extremes on the budget requirement. However good a single extended-range loudspeaker unit is made, it would never approach the cost of 10 separate units, each made for its own frequency range, with nine crossovers. So it might appear that the number of crossovers you use depends on your budget. But before our millionaire readers proceed to order 10-way loudspeaker systems, it should be pointed out that this extreme is not the ideal either.

While, if well designed, it would certainly do a wonderful job of providing a smooth frequency response and freedom from IM distortion, this is not all that is required of a system. In fact, from some aspects, it is not even the most important thing required of a system.

Smooth frequency response, as measured by steady tone testing, is one thing, but a smooth frequency response, as judged by listening to program material, often proves to be quite a different matter. This is because our listening is much more dependent upon the transient response of the system than its response to the steady tones used for testing.

If you put a loudspeaker inside the voice box of a pipe organ and opened all the pipe valves, the frequency response of the system, measured with a continuous gliding tone, would come out pretty close to flat. But can you imagine what the loudspeaker would sound like? You've guessed it, like a program being heard through a mass of tuned pipes. A 10-way system, it is true, would not be quite as bad as this,

an *average* curve. So a system should

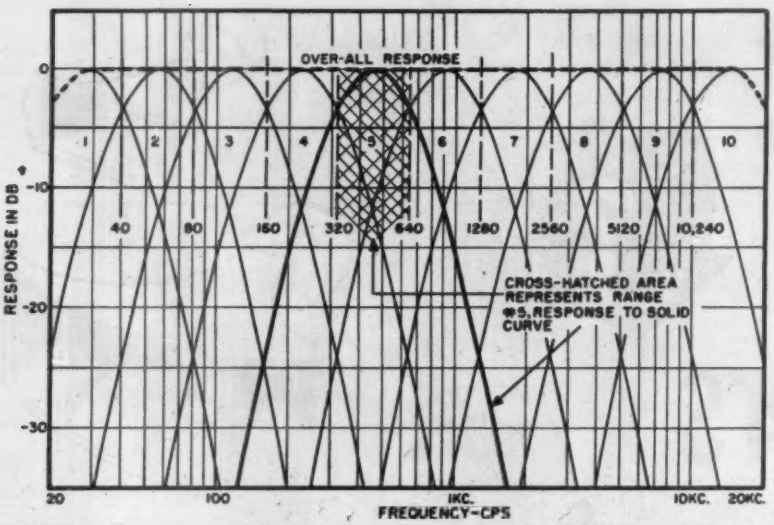


Fig. 1. Above curves show the division of the entire audio spectrum into ten octaves. This may be regarded as the very "ultimate" in the number of crossovers.

but it would follow the same general trend.

Each octave bandpass filter will need to have sharp cut-offs at each side if we are going to take full advantage of the way this system can minimize intermodulation distortion (Fig. 1). This would mean that tones in each band would set up a kind of ringing from the loudspeaker on the particular tone played, caused by the characteristics of the filter. It is true the "ring" would not be so pronounced as with a tuned pipe, but it would still result in reproduction with considerably more coloration than the simpler types of systems despite the fact that the steady tone response looks flat.

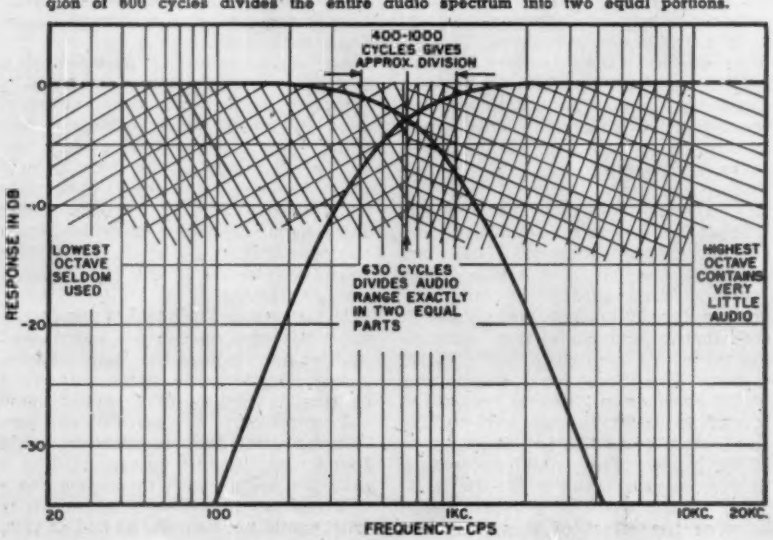
So there are disadvantages to both extremes. As a compromise, most loudspeaker systems now fall into the two-way or three-way classes, with a few going to four-way. Having narrowed down the number of crossovers to choose, we can now take the next question.

Where?

If you pick a two-way system, the logical crossover frequency will be somewhere in the region of 600 cycles. Actually anywhere between 400 and 1000 cycles would be satisfactory. The reason for this is that, whether you consider you need the frequency response to be from 20 cycles to 20,000 cycles, or from 40 cycles to 10,000 cycles, the middle of the range comes out to about 630 cycles. Since both halves are 4 or 5 octaves, it is not critical, within half an octave or so, to have the frequency at precisely 630 cycles. Anywhere between 400 and 1000 cycles will divide the spectrum approximately into two equal parts (Fig. 2).

If you take a three-way system and consider the spectrum as extending from 40 to 10,000 cycles, which is more like a reasonable extent, because there is very little audio "intelligence" in the 20 to 40 cycle range and in the 10,000 to 20,000 cycle range, dividing this part of the spectrum into three approximately equal parts will require crossovers at 250 cycles and 1600 cycles (Fig. 3).

Fig. 2. When a two-way system is employed, the use of a crossover in the region of 600 cycles divides the entire audio spectrum into two equal portions.



This choice of frequencies brings an interesting fact to light: 250 cycles is approximately the frequency of "middle C." Frequencies below this correspond to the bass part of musical reproduction, while frequencies above this correspond to treble. So this division gives us one band in the bass and two for the treble. Actually the range from 250 to 1600 cycles could be regarded as the treble, while the extreme high-frequency range from 1600 to 10,000 or 20,000 cycles is principally occupied by overtones and transients that provide *definition*. In speech the principal components in this top range are the consonant sounds due to "s," "t," and "d."

Dividing the spectrum four ways would require crossovers at approximately 160 cycles, 630 cycles, and 2500 cycles (Fig. 4).

This consideration has been based entirely on a consideration of the frequency spectrum. If you consult loudspeaker catalogues you'll find few systems that conform to the figures just given. This is because there are other factors that complicate the choice. Wherever you divide the spectrum, by means of a crossover, the lower frequencies are going to be reproduced by one loudspeaker while the frequencies above this point come from another. In a musical program, it is inevitable that the fundamental tones and possibly some of the lower harmonics of certain instruments will be reproduced by one loudspeaker while other overtones or higher frequencies will come from another unit. This is one of the undesirable features of multi-way systems.

Another factor that needs some consideration is the distribution of the dominant sound energy through the frequency spectrum. This should not be confused with the apparent loudness of different frequencies. Most curves of average energy spectrums will show there is not much in either speech or music below 100 or 200 cycles. But here the word *average* is important, especially for music. Bass notes are only evident in comparatively few passages, which is why an average curve shows them low. However, when low notes are present, they have considerable energy, and the system has to reproduce this energy—not an average figure.

At the other end, there is not much energy in speech above 500 to 1000 cycles, but the small energy present is very important to intelligibility, to carry consonant sounds, particularly "s," "t," and "d." Musical energy, too, tails off above 1500 to 2500 cycles, except for short bursts from the percussion, which again do not show up on

an *average* curve. So a system should be able to handle more or less uniform power peaks over the range from about 40 to 2500 cycles, and should be reasonably flat in response (at lower levels) from 20 to 20,000 cycles or, as a secondary standard, from 40 to 10,000 cycles.

Consequently a more usual approach is to cover as much as possible of the frequency range with the mid-range unit. That is, we take as much as the mid-range unit can comfortably handle without running into difficulties with frequency response and intermodulation, then the part that the mid-range unit cannot comfortably handle is delegated, at the low end to the woofer and at the high end to the tweeter.

Fortunately this integration problem is not very important at the low-frequency end. By the time you get down to 250 cycles, the wavelength is four feet. As the biggest loudspeaker system doesn't usually exceed this dimension in one direction, you are not going to suffer noticeable lack of integration between frequencies below and above 250 cycles, or any similar crossover frequency for that matter. So, to maintain good integration, the usual practice is to use as low a crossover as possible without running into intermodulation problems.

If better integration can be achieved at the high end by pushing the crossover up to, say 5000 cycles, then we may raise the lower crossover frequency as high as, say, 600 cycles. Then the tweeter will just handle frequencies from 5000 cycles on up, where the mid-range unit runs into serious break-up problems. The tweeter will maintain the smoothness of response at the high end.

A crossover around 600 cycles is not likely to run into serious integration problems provided satisfactory transition is achieved in the 600 cycle region. More of this in a moment, however. If 600 cycles is the crossover point from the low frequency to the mid-range unit, the range from 20 cycles, or even 40 cycles, up to 600 cycles is rather wider than any of the other ranges. This is the reason for going to four-way systems. A unit to handle all the frequencies below 600 cycles can still cause intermodulation. Such division is not usually necessary in the smaller living rooms with a well-designed enclosure. Only with the larger systems, where the low-frequency unit has to encounter considerable diaphragm movements at the bottom end of its range, is this a necessity to minimize intermodulation.

How Much?

So much for the question of the different possibilities in frequency of crossovers. Next we come to the sharpness of the slope. Different crossovers employ different degrees of separation between the frequencies. The simplest kind of crossover uses just an inductance or a capacitance for each individual channel. This provides an ulti-

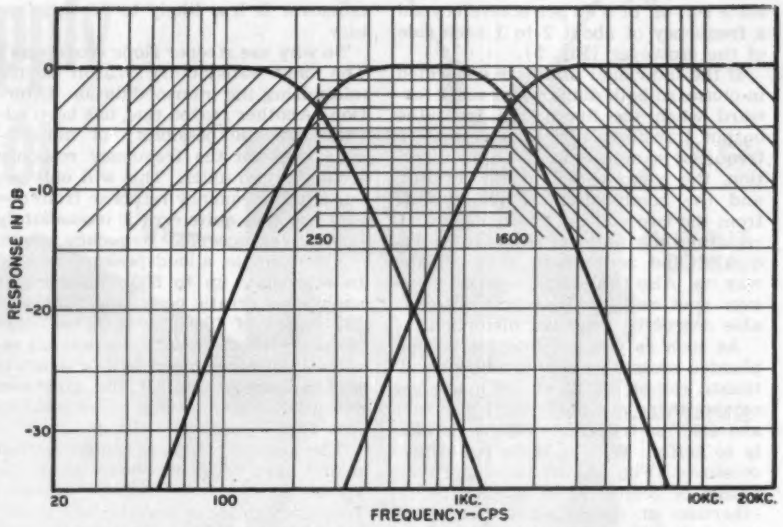


Fig. 3. If it is desired to divide the more useful part of the entire audio spectrum into three equal portions, crossovers would be required at the frequencies of about 250 and 1600 cycles. A three-way system would use such values.

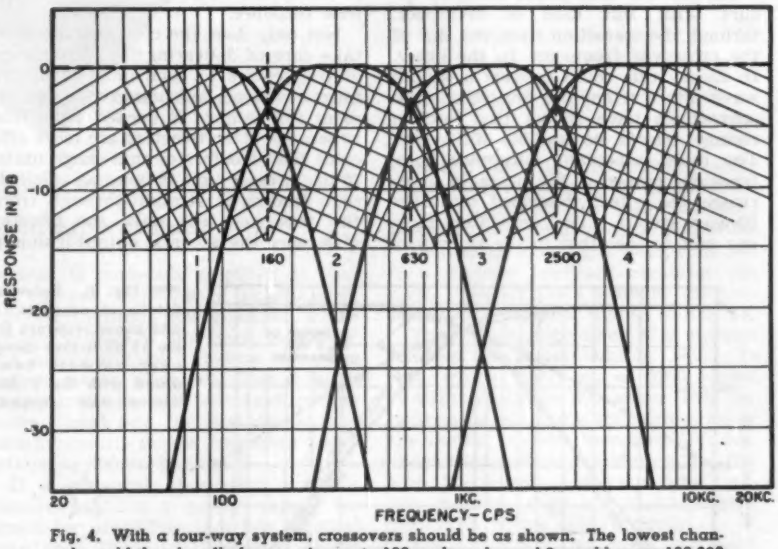


Fig. 4. With a four-way system, crossovers should be as shown. The lowest channel would then handle frequencies up to 160 cycles; channel 2 would cover 160-630 cps; channel 3, 630-2500 cps; and channel 4 would cover all above 2500 cps.

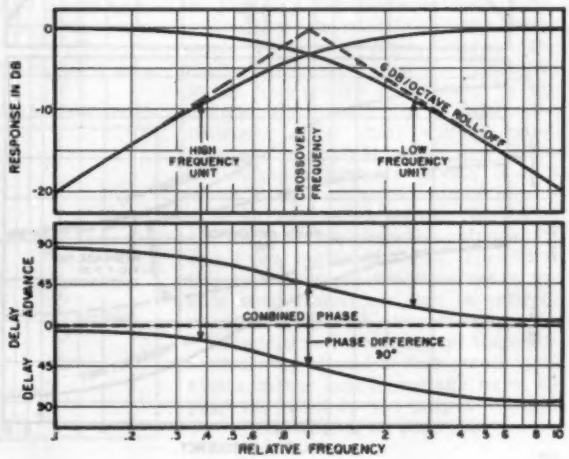


Fig. 5. Here are the amplitude and the phase response curves for crossover networks having a 6 db/octave slope. Note that at the crossover frequency the phase difference amounts to 90 degrees.

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mate roll-off of 6 db per octave beyond a frequency of about 2 to 1 each side of the crossover (Fig. 5).

If the individual units are connected in-phase, so both diaphragms move forward when the fluctuation from the output transformer in their respective frequency ranges is in the same direction, the response will come out flat, and the combination of phase shift from the two will neutralize or cancel, resulting in a uniform response in frequency and zero phase shift all the way up. Also this simple kind of crossover does not introduce any measurable degree of transient distortion.

As soon as you get into more complicated crossovers that produce an ultimate roll-off of 12 db, or more, per octave, there are phase shift problems and also the transient response is likely to suffer. With a 12 db per octave crossover (Fig. 6), the two voice coils should be connected in *opposite* phase, otherwise at the crossover frequency they will be moving in opposite directions and cancel, producing a "hole" in the frequency response.

This means that phase reversal occurs with this kind of crossover, through the transition from one side of the crossover frequency to the other. In theory this could convert a square wave into a triangular one. But demonstrations have shown that such a change makes no *audible* difference. The more important difference is in transient response. We begin to experience the effect described with the 10-way system. The transition from one unit to the other in the vicinity of crossover is less likely to be satisfactory.

So why use steeper slope crossovers? The only satisfactory reason is for minimizing the intermodulation distortion. Another reason that has been advanced is the possibility of interference between the frequency response from the two units. This will only occur if the frequency response from one unit becomes quite erratic *immediately beyond the accepted frequency range.*

For example, a loudspeaker intended to reproduce up to 600 cycles might show some erratic peaks and valleys in the region of 1000 cycles. This could seriously interfere with the over-all response when combined with a separate high-frequency unit, if the crossover was of the simple type (See illustration Fig. 7).

The answer to this argument is that a unit that becomes erratic in its response so shortly beyond the accepted frequency range is probably not a very good unit *within* the accepted frequency range, although its response may look good. Its transient response will certainly not be as good as the steady tone response.

Not only does the crossover have to take care of delivering the right range of frequencies to each unit, with uniform coverage, but sometimes adjustment for balance is needed too. This is because often tweeters are more efficient than woofers or mid-range units. If the tweeter unit is twice as efficient, then feeding it straight-through from the crossover will make the tweeter give twice the acoustic output it should to maintain balance. To care for this, a good crossover should incorporate an attenuator, or balance control, so the output *in acoustic watts* can be balanced to take care of differences in efficiency between units.

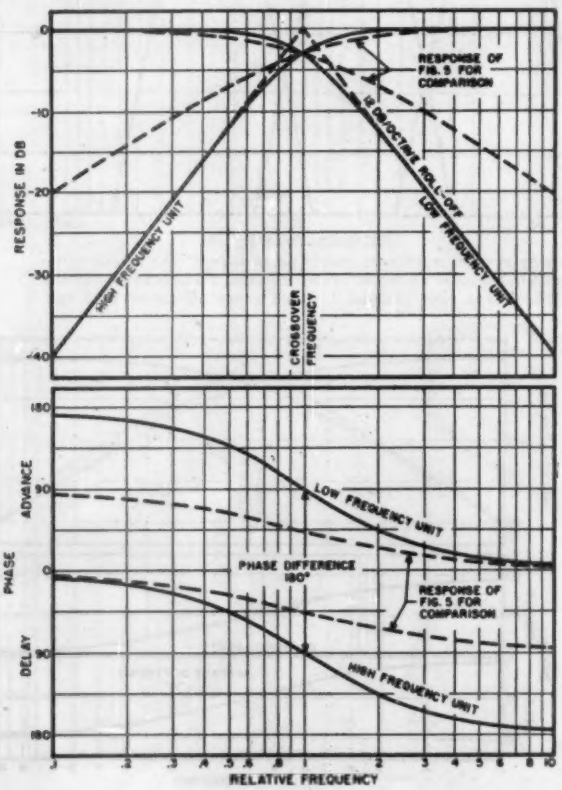
This brings up another question—what controls to look for on a crossover. In turn, this could lead into a much more complicated article, because there is such a variety of ways adjustments can be made; but let's keep it simple. Only electronic dividing networks have continuously variable controls, either of crossover frequency or slope of roll-off, and that's another subject. But some crossovers for use in loudspeaker circuits have adjustments that can be made in steps, either to change the slope or the frequency. This may be done by changing capacitor elements, or by changing taps on inductors, or both. If you buy a unit with these facilities, make sure it comes with sufficient instructions, so you know *exactly* what it can do. Don't be satisfied with a vague promotion statement, such as "this unit is adjustable to suit your system's exact requirements." Having three or four possible ways of connecting it will probably insure that one way will sound better than the others, but it does not insure that any of them are *right.*

You would do better to buy a unit with only one (right) way of connecting it, than a "versatile" unit with inadequate information, so you do not know what each position does. If it comes with complete information you will be able to check that it does provide facilities for crossing over where you want it to, and for feeding units at the impedance of your system (4, 8, or 16 ohms).

By and large, then, the recommendation seems to favor using the simpler crossover and units designed to have a good response, not only within the range for which they are intended, but also at least an octave beyond the nominal crossover frequency. Then the over-all response, both to transients and intermodulation distortion tests, should be quite acceptable.

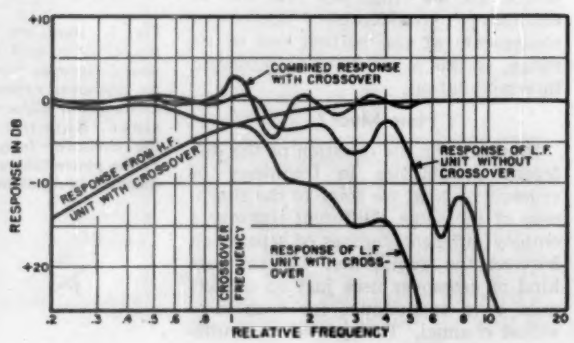
We have spoken about the question of integration. A few more words of explanation might be in order here. By integration we mean the radiation of sound as if the whole frequency spectrum "belongs." This can perhaps best

(*Continued on page* 100)

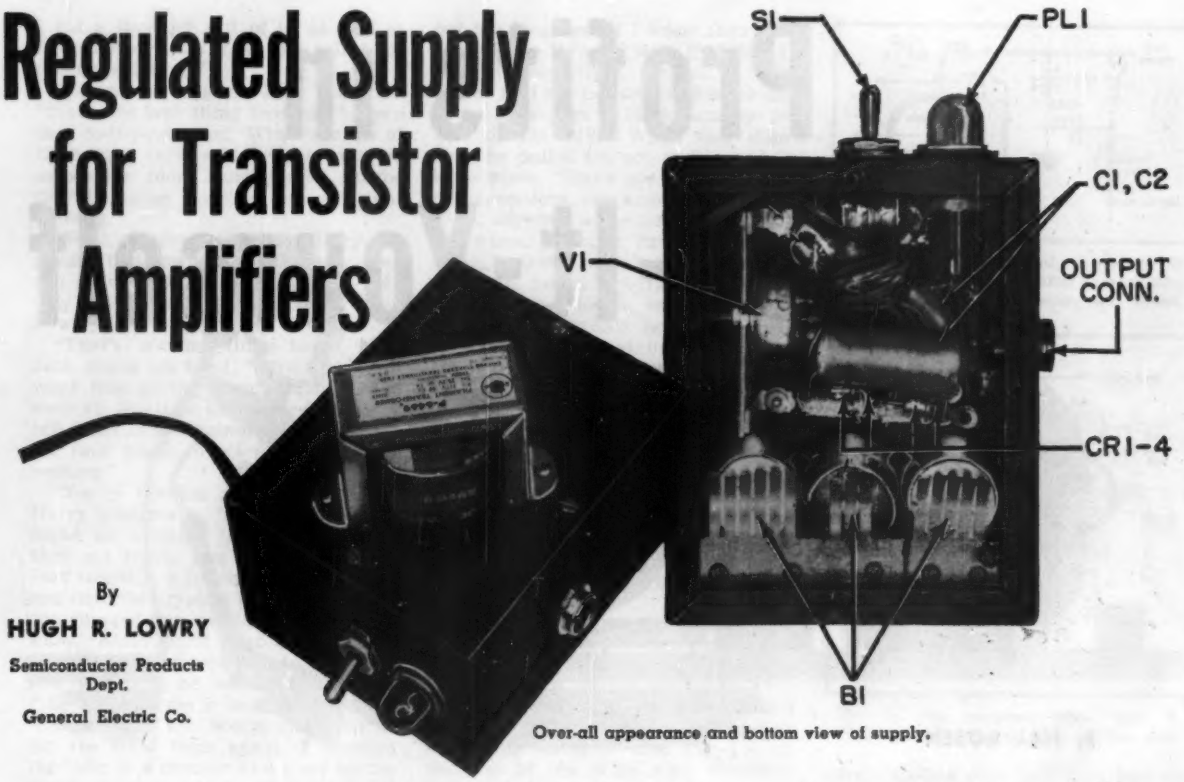


← Fig. 6. Relevant details of amplitude and phase response for the 12 db/octave crossover network compared with the 6 db/octave unit (dashed).

Fig. 7. These curves show why the response that exists beyond the accepted range (of the low-frequency unit in this case) can be important to the system. ↓


+10
0
-10
+20
RESPONSE IN DB
COMBINED RESPONSE WITH CROSSOVER
RESPONSE FROM H.F. UNIT WITH CROSSOVER
RESPONSE OF L.F. UNIT WITHOUT CROSSOVER
RESPONSE OF L.F. UNIT WITH CROSSOVER
CROSSOVER FREQUENCY
.2 .3 .4 .5 .6 .8 1 2 3 4 5 6 8 10 20
RELATIVE FREQUENCY

Regulated Supply for Transistor Amplifiers



Over-all appearance and bottom view of supply.

By
HUGH R. LOWRY
Semiconductor Products Dept.
General Electric Co.

Simple, low cost regulated power source for high power transistor amplifiers and experimentation.

WHEN transistors first appeared, their use was almost entirely limited to portable radios where the advantages of small size and low power drain more than offset the disadvantage of high cost. Within the past year as prices have dropped and higher power units have become available, transistors are being designed into equipment which is not necessarily portable. A recent example of this is an all-transistor "hi-fi" transistor amplifier[1] incorporating a preamplifier for magnetic cartridges, tone controls, and having sufficient output power for ordinary home listening. The current drain of such transistorized equipment is so large (up to 0.3 amp. peaks) that the use of anything but a rechargeable storage battery or a regulated power supply working from a power line is not feasible. This article describes a simple, low cost regulated power supply suitable as a power source for high power transistor amplifiers and general experimentation.

The majority of transistor audio amplifiers use class B push-pull output stages because the maximum sine-wave output power of a class B push-pull amplifier is five times the allowable power dissipation of each transistor. In contrast, the maximum output power of a class A push-pull transistor amplifier is only the same as the allowable dissipation of each transistor. The major disadvantage of a class B push-pull amplifier is that the current drain varies directly with the instantaneous power output. If the supply voltage is not well regulated, the supply voltage will drop when the output power increases. This drop in supply voltage will re-introduce the audio signal into the first stages and usually results in low frequency oscillations or "motorboating."

It is apparent, then, that a prime requirement for a power supply for transistor amplifiers is a low internal resistance. There are many well known circuits for feedback-type regulated power supplies using vacuum tubes and an obvious procedure would be to simply "transistorize" one of these circuits.

Merely using transistors in a conventional vacuum-tube circuit rarely makes optimum use of the unique properties of transistors and regulated power supply circuitry is no exception.

Instead of starting a design similar to multi-tube feedback regulator circuits, consider for a moment the simple cathode follower, shown in Fig. 1A.

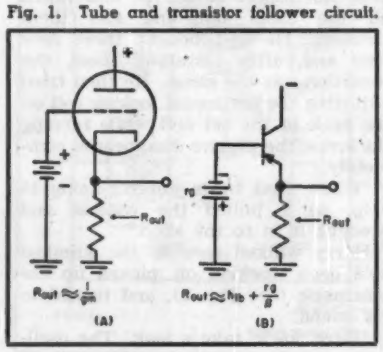
The output impedance of a cathode follower is approximately equal to $1/g_m$ which, for a g_m of 5000 μmhos (6AS7), would be 200 ohms. This impedance is obviously too high since, if the output current increased 100 ma., the output voltage would drop 20 volts. For this reason, a vacuum-tube cathode follower does not make a good regulated power supply circuit.

The situation is quite different, however, in an emitter-follower circuit using a power transistor, as shown in Fig. 1B. The dynamic output impedance of an emitter-follower transistor circuit is approximately the emitter resistance plus the resistance in the base circuit (r_g) divided by the current gain, *beta*. For a fairly low resistance (100 ohm) voltage reference and a typical power transistor, the output impedance is only 2 or 3 ohms. With such a low output impedance an increase in output current of 100 ma. will only drop the output voltage a few tenths of a volt. Therefore, this type of regulator circuitry is usable with transistors, but is entirely unsatisfactory with vacuum tubes.

An additional advantage of the emitter-follower circuit is that small variations in the supply voltage have almost no effect on the output voltage.

(*Continued on page* 193)

Fig. 1. Tube and transistor follower circuit.



Profits in Do-It-Yourself Repairs

By **HAL ROSEN**

A view of the do-it-yourself addict as a good service customer rather than an industry menace.

A GRIN creased Harry's face as he realized he'd found it. Humming softy, he turned the switch off and reached for a pair of clip leads. After clipping in at the proper points he switched the set on again and waited confidently. In a few seconds his practiced ears caught the tune of 15,750 cycles. He adjusted the horizontal frequency and was surveying the picture when the front door buzzer informed him someone was entering the store. As he rose from the bench he heard the footsteps continuing on around the counter and realized it was not a customer.

"Hiya Jack," he greeted the head poking through the curtain, "what are you doing over in this neck of the woods?"

"Had a call not too far from here," the newcomer replied, as he settled into a chair, "cutting into your territory, huh?"

"Not at all," shrugged Harry, "this is a big city, there's plenty here for all of us."

"Plenty? I don't know, Harry, I've been slow and it seems to be getting slower. I think I know why, too; it's these darn do-it-yourselfers. You find tube testers in drug stores, supermarkets and, for all we know, barber shops. Do you realize just how many calls we're losing because of people testing their own tubes?"

"You're right," Harry nodded knowingly, "but there're two sides to the story. Do you realize just how many shop jobs we're getting because of 'induced' troubles?"

"What kind of trouble?"

"Induced trouble," Harry replied, "trouble that doesn't originate in the set itself, but is induced, usually by some inexperienced person tampering with it. You must have come across some jobs like that?

"Here's a good example right here," Harry went on, "I was working on it when you came in. When I first examined the set in the customer's home, there was no raster. While I checked the high voltage and horizontal tubes, he told me his original trouble had been horizontal bars. He had taken all the tubes out and had them checked. He had bought three new ones and, after installing them, the condition was the same. He then tried adjusting the horizontal locking coil on the back of the set and while turning the screw the picture disappeared completely.

"I saw that tubes weren't going to help, so I pulled the chassis and brought it in to the shop."

Harry walked over to the *Admiral* he'd been working on, picked up the schematic (see Fig. 1), and turned to his friend.

"Here, Jack, take a look. The oscillator gets its voltage directly from 'B+,' so I started taking voltage checks at the plates. Pin 1 of V_{608} measured zero volts. I jumped ahead of the 5600-ohm resistor, R_{628}; still no voltage. Then, across the coil, L_{601}, I got my 270 volts. Simple enough, I figured, the coil is open. However, when I measured from lug to lug, I got the correct resistance reading. I checked the circuit to see if the tube or any of the capacitors were shorting the voltage to ground, but, if so, the 5600-ohm, ½ watt resistor, R_{628}, would burn, but it was good.

"Well, while this was going on, I thought back to the conversation with the customer and realized what had happened. He'd mentioned adjusting the coil, you recall. Now, notice that this can is mounted on a printed circuit board, and the coil lugs are soldered right into the strip. What the customer did was to continue turning the core 'til it reached the end, then when he tried to force it farther, the pressure on the can parted it from the printed circuit. Here, look, the breaks are so fine, you can hardly see them. I used these jumpers to check it out and it works fine. I'll just get out my low-wattage iron and solder the lugs back. That will doubtless get the set in working order again without any further difficulties.

"Now, the whole point here is; the customer actually fixed the set himself, by replacing the horizontal oscillator tube. However, he didn't know how to complete the job. When he tried, he just made more trouble, and

I got a shop job out of it, as well as more money than if he had called me in the beginning."

"Serves him right," Jack spat out, "that's the best thing that can happen to a do-it-yourselfer. When enough of them ruin their sets or get knocked across the room from shocks, maybe they'll realize they've got no right messing."

"Well, remember, boy," Harry replied, "they own the television, they can do what they please with it. My only advice is that they learn when to stop."

"That's another thing burns me," Jack shook his head, "advice, they all want free advice, keep coming in the shop all the time and pestering me to tell them, in four minutes, what it took me four years to learn. I tell them nothing."

"You're making a mistake there," Harry disagreed. "I've found if you make an attempt to help them and they get stuck, you will get the job. Just recently, a fellow stopped in here and described typical 6BQ7 symptoms; one channel fair and the others full of snow. Although it hurt a bit, I sold him a tube and told him to try it. A few days later he walked in with the tube and told me it had corrected the trouble for a few hours, and then he got the snow back again. I checked the tube in a checker and a set on the bench; it seemed to be all right, but I gave him another one anyhow, and off he went. Two hours later he was back, this time with the whole set, a *Philco*. He told me it was the same with the new tube and he was tired taking the back off and on, so would I please fix it.

"I took a look at the set the next day, and found the same symptoms he'd described. I was pretty certain it was tuner trouble and started right in checking voltages in the tuner. (See Fig. 2.) Pin 1 of the 6BQ7, normally 215 volts, measured zero. This plate gets its voltage from 'B+' through a tuner coil and a 1000-ohm resistor. The latter proved to be the culprit. After a bit of a struggle mounting and soldering the new one, I had the set playing again without the snowstorm. I figured the original tube must have shorted internally, allowing 'B+' to get to ground. The heavy current flow through the resistor (R_{506}) must have charred it and caused it to change value. Usually, when that happens, a new tube will apparently correct the trouble, but in a short while the snow returns, just as my customer described.

"The next day, when he picked the set up, he thanked me, and apologized for being so much trouble. He also promised me all his future business. Now, I'm sure, if I had chased him when he first came in for advice, I wouldn't have gotten the job."

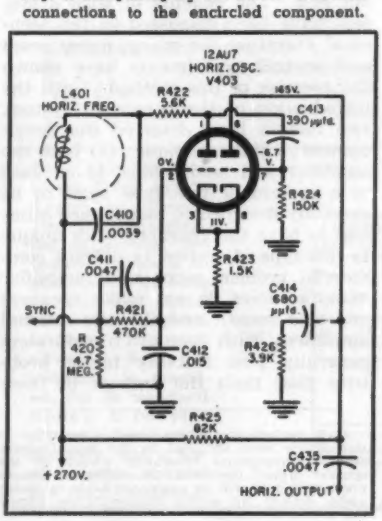
"I see what you mean," Jack said, "but how are you going to pick the good ones from the bad? Some of these guys mess up a set so, I'd rather not have the job. I had one like that not too long ago; if I knew then what I would go through with that set, I'd have walked right out on it. The owner told me he had tried some new tubes to correct a black, smeary picture on his *RCA*. When they didn't help, he pulled the set and looked for loose wires. That's one of their favorite expressions, you know, 'loose wires'. Well, anyhow, while he was checking the wires, he must have done something, because, when he turned the set on again, he had no raster. I got it back, quick enough, by opening the drive control, which he had screwed in tight. What that has to do with the wires, he never explained. Then, I was back where he started, with a black smeary picture. A new 6CB6 a.g.c. amplifier helped this condition, but the pictures were still pretty strong. After checking all i. f., video, and tuner tubes with no luck, I told him it would have to be taken into the shop. As I carried it out, I could hear him moaning and his wife screaming that he should have left it alone in the first place.

"When I got it on the bench, I installed a bias box between ground and the a.g.c. bus and with it I was able to control the picture strength. That indicated trouble in the a.g.c. circuit itself, so I dug right in and started measuring voltages. (See Fig. 3.) All the pins of the 6CB6 a.g.c. amplifier were about right, except the plate; it measured 6 volts instead of about 4 volts. Well, I went through that circuit from stem to stern, measuring resistors, changing capacitors, changing resistors; nothing helped. After a few hours of that, disgusted and with the back of my neck starting to burn, I got up and walked away from it. I was tempted to bring it over here to you for help but I thought I'd take one more crack at it.

"Have you got one of those middle-aged *RCA* schematics, Harry, I'd like to show you this."

Harry gestured toward the file cabinet standing against the wall. His

Fig. 1. Tampering by the owner loosened connections to the encircled component.



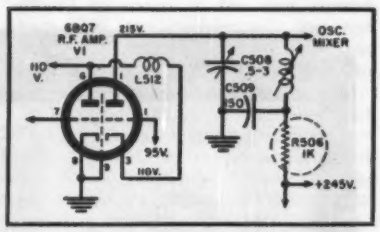


Fig. 2. Replacement of a resistor finally eliminated snow after several tube changes by the set owner had failed.

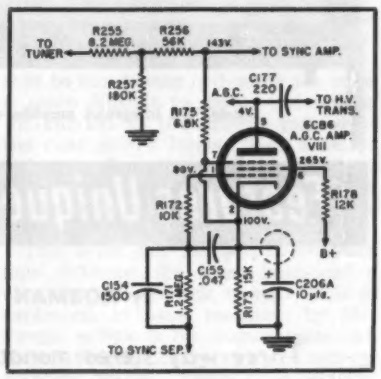


Fig. 3. The customer was right! A "loose wire" was at fault in this one.

friend walked over and soon had the print spread in front of him.

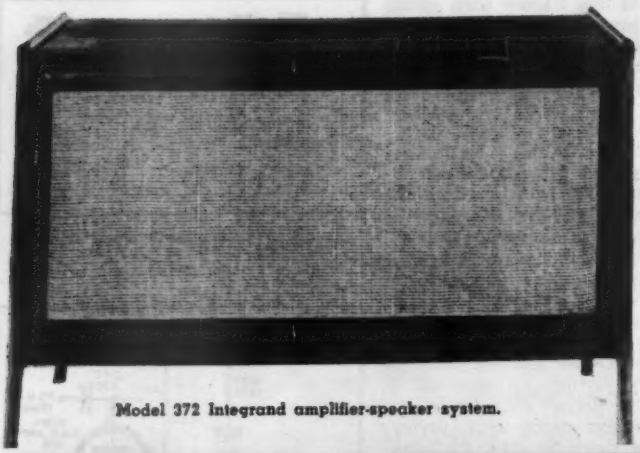
"The next day," he went on, "in a little better frame of mind, I started all over again, changing and checking the same parts as the day before. Lo and behold, when I jumped this filter capacitor, C_{xxx}, in the cathode, the picture came in light and clear. Now I had definitely checked it the day before, but I shrugged that off and soldered in a new one. When I turned the set on and the picture came in, black and strong again, I made a mental note to close up the shop and go get a job in some industrial plant. Suspecting the new capacitor, I jumped another one in from ground to the cathode and the trouble disappeared. Then, on a hunch, I jumped it from ground to the plus side of the newly installed capacitor; you guessed it, a.g.c. trouble again. I measured the resistance from the cathode of the tube to the plus side of the can, and it was infinite. The customer had been right, it *was* a loose wire. The insulated lead from the can to the tube socket is a long one and he must have snapped it inside the insulation when he started pulling on the wires. Effectively, it was like an open filter, which caused the a.g.c. to degenerate, overloading the r.f. and i.f. amplifiers. All the set needed originally, before he got to it, was a 6CB6 a.g.c. amplifier.

"When I returned the set, this joker gives me a hard time about the labor charge, just for finding a loose wire, especially when he'd known what the trouble was all along. What are you gonna do with a guy like that?"

"There's not much you can do,"

(*Continued on page* 144)

New Hi-Fi Speaker System



Model 372 Integrand amplifier-speaker system.

-Features Unique Design Principles

By **NORMAN H. CROWHURST**

Three-way stereo-monaural unit includes its own transistorized, transformerless power amplifiers. Feedback obtained directly from special loudspeakers.

HERE IS A speaker system employing unique principles that have never been used commercially. This very unusual three-way system uses specially constructed loudspeakers and includes high-power transistorized amplifiers coupled to their respective speakers without the use of output transformers. Feedback taken directly from special sensing coils on the speakers themselves is used to correct for distortion that arises in the speakers as well as the amplifiers. It is even possible to smooth out the peaks and booms that are contributed by poor room acoustics. The model shown above actually includes a dual three-way system in which both sections are operated in parallel for monaural reproduction and separately for stereo sound.

Each three-way system is made up of a low-frequency speaker of 15-inch diameter with transistor crossover networks providing for a 350 cps crossover. The feedback amplifier used with the woofer causes the acoustic output to have the damping and response characteristics obtainable only in large theater horns, yet no low-frequency horns are used. The mid-range ring radiator is mounted coplanar as well as coaxial with its high-frequency radiator, resulting in a smooth, low-distortion crossover at 2500 cps. This crossover is developed by transistor networks. The tweeter itself consists of a multicellular ring radiator with a new type of acoustic termination that eliminates the large standing-wave dip (at about 11,000 to 12,000 cps) that exists in a good many high-frequency horn-type radiators.

According to the manufacturer, *Integrand Corporation*, the Model 372 shown above has a response within 3 db from 30 to 16,000 cps, with useful response from 20 to 20,000 cps.[1] The acoustic distortion at a sound output of 1 acoustic watt is less than 1 per-cent from 30 to 200 cps, less than ½ per-cent from 200 to 800 cps, and less than 1 per-cent from 8000 to 16,000 cps. The total electrical power output of the self-contained amplifiers is 72 watts, with 1 volt signal input required for full power output.

The idea of using a separate coil on a loudspeaker to provide feedback is not new. The benefits of such a system have been discussed in the technical literature for many, many years and several experiments have shown the promise of this method. Until the introduction of the *Integrand* system, two factors have deterred the development of this technique: (1) both the amplifier and loudspeaker to be used in a system of this type have to be carefully designed to match each other and to have the characteristics unique to this type of system (a difficult commercial problem since most amplifier manufacturers do not make speakers and *vice versa*), and (2) conventional amplifiers with output transformers generally pose stability factor problems that limit the amount of feedback that can be obtained by this method (as a consequence, the use of this method in conventional systems does not offer enough advantage to warrant its general use). The OTL's (*O*utput *T*ransformer-*L*ess amplifiers) that have appeared recently are generally expensive and difficult to maintain in balance. Since they still have a relatively high output impedance, they require expensive and fragile high-resistance voice-coil loudspeakers.

Assuming that one could purchase rugged, transformerless output amplifiers and speakers of the type used in this system, it is unlikely that the average high-fidelity enthusiast could home assemble them and still reap the benefits of such a system. This is due to the complex feedback networks required to stabilize such a system, for they would change to some extent, depending on the speaker enclosure. The manufacturer, realizing this, chose to package a complete system in a single cabinet containing the loudspeaker units and the associated drive amplifiers. This means that the high-fidelity enthusiast can couple directly into this system from the output of his conventional preamplifier or radio tuner (or tape deck) without the need for the high-power amplifiers (or crossovers) required of other loudspeaker systems.

This system uses separate, transistorized power amplifiers (each containing a transistorized crossover dividing network) to drive each unit of a three-way loudspeaker system. This makes it possible to (1) couple directly from the amplifier to a loudspeaker unit with a reasonable voice-coil resistance, and (2) since the output transformer has been eliminated (and the transistor amplifiers are directly coupled over several stages), a large amount of feedback can be used from the feedback coils of the loudspeaker units.

[1] All performance characteristics included in this article were obtained by the manufacturer from developmental laboratory models of the speaker system described. According to present plans this unit will be made available to major audio dealers for public demonstration during the month of October.

This system provides a completely new approach to the solution of some of the problems encountered in building a hi-fi system. Previously, amplifier manufacturers have had to design amplifiers to deliver electrical power. The only satisfactory method of measuring their performance is with a resistance load to absorb the power output, rather than with a loudspeaker. While manufacturers have naturally been concerned that their amplifiers work successfully with loudspeakers, the problem has always been to tell just *how* successfully this has been done.

An amplifier may work well with one loudspeaker but not so well with another, even though both units are basically well designed and constructed. (This should not be construed as a reflection on either the amplifiers or the speakers, but rather underlines the problems connected with building a hi-fi system.)

The *Integrand* approach retains the advantages of the component system by providing just a speaker system so that you are still able to select whatever "front end" units you fancy, while giving you the advantages of amplifiers and speakers that are literally born for each other. To distinguish this from either the package or the component approach, as used heretofore, we might call this the "Integrated Component System"—the beginning of a trend that may well mark new milestones in the field.

The use of direct-coupled transistorized amplification makes possible the full use of real *over-all* feedback, not just over all the amplifiers, *but the loudspeaker as well.* With proper design techniques, transistor amplifiers give us as clean an output as tube amplifiers. With the same amount of feedback, the distortion from the amplifier will be as low as it is from the best tube amplifiers when they are connected to that "dummy" resistance load that you can't hear, But, in this case, the feedback can be made to buy you a number of bonuses, too.

When the specially designed loudspeakers are placed in their feedback loops, the distortion reduction resulting from the feedback occurs not only in the amplifier, but applies equally to the mechanical action of the loudspeaker unit. To illuminate this more fully, let us discuss the kind of distortions that occur in a loudspeaker, apart from the variations in frequency response.

The output current of the amplifier flows through the voice coil and creates a magnetic field that interacts with the field created by the permanent magnet of the speaker. The permanent magnetic field in which the voice coil moves is never perfectly uniform and hence the voice coil motion, as dictated by the amplifier output current, must reflect the non-uniformities of this field. Any failure of the voice coil drive to "obey" the amplifier output current precisely constitutes distortion. Another source of distortion is the suspension system of the diaphragm. In the electrodynamic speaker, this usually consists of (1) the spider that keeps the voice coil centered in the magnetic gap and (2) the surround which is the support for the cone around its periphery. Non-uniformities in the deflecting constants of these members contribute additional distortion components to the voice coil motion.

Using negative feedback from the voice coil of the loudspeaker, when there is only *one* voice coil, can reduce *some* of the distortion, but it can never work successfully on both forms. Both forms distort the current taken by the voice coil, while one form distorts the voltage needed as well. The amplifier, even with negative damping, has no means of "knowing" how much of each kind of correction is needed. But, by the use of a separate feedback winding on the voice coil, as is done in this new system, the resultant feedback voltage enables both forms of distortion to be "worked on" equally well. In addition, these distortions will be reduced by the same factors as all other distortions, including those in the amplifier.

This is how this method of feedback can reduce waveform distortion due to the speaker as well as the amplifier. It must be noted here that, for a long while, the average amplifier has been producing much less distortion than even the best loudspeaker unit, so that this is an important difference. But this type of feedback which includes the loudspeaker not only "shapes up" waveforms to what they ought to be—it also smooths out the frequency response.

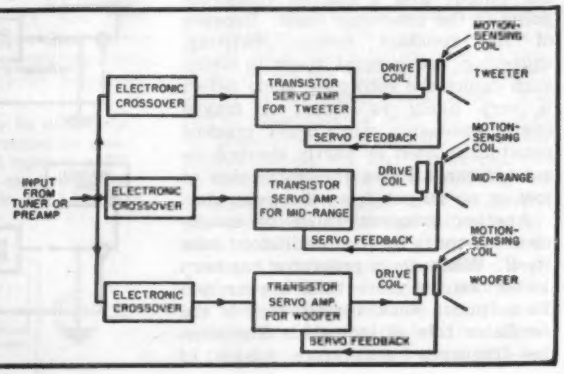
Effective feedback must work instantaneously. Any time delay renders it incapable of reducing distortion. For this reason, the feedback coil must be rigidly fixed to the cone, the same as the drive coil is. For feedback to be effective, the feedback voltage must be directly dependent on the movement, which requires a small working coil in the uniform portion of the magnetic field. But more about that when we get to it.

Due to the inherent low efficiency of most loudspeaker units, the current in the coil only partially establishes the cone displacement. If the cone, or the air it drives in turn, requires more "effort" to move it for any reason whatsoever, the current will just not move it as much as it should. This is where the feedback again comes to the rescue.

In any loudspeaker, cone movement is resisted due to compression of air inside the enclosure, particularly at some frequencies. At other frequencies, a cabinet resonance effect may cause the cone to move more readily. When the cone moves more readily, this frequency is accentuated giving a peak or resonance. When the cone moves more stiffly, the frequency is diminished or a trough appears. The effect of the *Integrand* feedback system, however, is to increase the current to the driving coil when the cone is more difficult to move, and reduce the current to the driving coil when the cone moves freely. This smooths out the *movement* of the cone, irrespective of the acoustic properties of the loudspeaker unit or its related enclosure.

This is not all. Did you ever notice how different the same loudspeaker can sound in different rooms? This is explained, in some measure, by Mr. Briggs' article in the August issue. At certain frequencies, every room sets up standing waves. These have exactly the same effect on the cone of the loudspeaker as do the resonances and anti-resonances inside the enclosure, but not quite as much because the room is much bigger and hence the effects are more dispersed. But at some frequencies, the cone moves more readily and, at others, more stiffly due to standing wave effects from the room itself.

The method of drive used in this new system makes it possible to compensate *automatically* for this. Not only does it compensate for the effect of standing waves, it also takes care of how they build up. When a certain frequency starts to come from the loudspeaker, there is no standing wave because it does not have time to travel across the room and back. So, *at the beginning,* the room dimensions do nothing to this particular frequency. Only when a few cycles have had time to fill the room with a standing wave, does this affect the cone movement. The feedback, accordingly, only makes corrections when the effect begins to show. (*Continued on page* 127)



Basic block diagram of the 3-way system described above. Two of these operating in parallel are used for monaural reproduction in the Model 372. For stereo, one 3-way system is used for each channel. Suitable switching is provided. For the monaural model, 2 tweeter channels, 2 mid-range channels, and a single woofer channel are then combined.

Maintain and Repair Your Own Signal Generator

Several representative signal generators designed for service-shop use.

You can repair, calibrate, and maintain your signal generator without special equipment.

IN THE article "Maintain and Repair Your Own Sweep Generator" which appeared in the June, 1957 issue of this magazine, we pointed out how the technician could profitably employ his spare moments by getting his test equipment into A-1 shape. Here we would like to discuss the repair and calibration of signal generators of the type used as markers for visual TV alignment as well as in AM and FM servicing. Radio hams and experimenters often use equipment of this type as do shops engaged in mobile or industrial electronic servicing. Next to meters and scopes, the signal generator is probably the most frequently used test instrument and much of its usefulness depends on the reliability of its dial readings. In most generators the frequency and output amplitudes are the important values and must be known exactly. Percentage modulation, either AM or FM, is rarely metered in generators used for servicing.

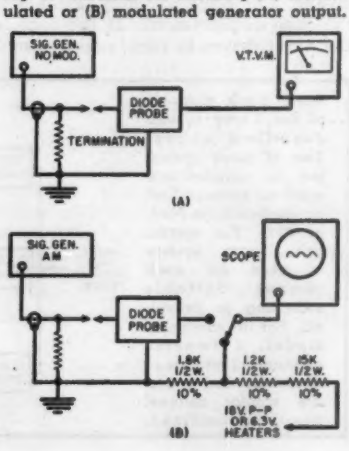
This article will describe repairs, calibration, and performance checks for signal generators covering the range from audio to TV frequencies. The accuracy of any calibration and performance check will depend both on the available standards of comparison and measurement and the capabilities of the generator under test. We shall present some methods which can provide extremely accurate frequency calibration and indicate how output power can be determined within very close tolerances. Whether such readings could be repeated after a few weeks depends on the type of generator. Actual calibration of a number of inexpensive signal generators has convinced us that even home-built kits show surprising stability once they are correctly assembled and properly aligned.

Troubleshooting

The test equipment section of one large electronic manufacturer has a rule that all equipment reported as defective must get a new set of cables and probes before troubleshooting starts. They find that just by changing cables a good percentage of the apparently "dead" generators are restored to duty. The reason for this lies in the fact that almost all signal generator cables have a termination at the output and a coaxial connector going to the generator itself. Because of the constant flexing, twisting, squeezing, and general abuse to which such cables are subjected, some defect is very likely to occur. A frayed center conductor, worn braid, cracked resistor, shorted or partly shorted insulator can all give the impression of low or no output from the generator.

Another frequent cause of insufficient output is the oscillator tube itself. Whenever a generator has been in service for more than a year and its output is weak, replacement of the oscillator tube is indicated. For most low-frequency generators this is rather simple, but in some v.h.f. units dismantling of part of the oscillator tuning assembly may be necessary. There are several ways to check the output of a generator depending on whether audio modulation is available, whether a good receiver, a sensitive v.t.v.m., or an oscilloscope is at hand. For accurate measurements of r.f. energy a thermistor and bridge circuit is used but since most service shops do not have such specialized equipment, less sensitive methods are suggested. The simplest method is to connect a diode probe to the generator output, as shown in Fig. 1A, and measure the d.c. output of the probe. This requires a v.t.v.m. capable of reading 0.1 volt or less.

Fig. 1. Methods for checking (A) unmodulated or (B) modulated generator output.



When audio modulation of the signal is available, the output of the diode probe can be connected to the vertical input of an oscilloscope and measured there. Calibrating the scope for 1.8 volts is easily accomplished by means of the circuit shown in Fig. 1B. If the vertical gain is set so that 1.8 volts peak-to-peak covers 36 divisions on the scale, each division will represent 0.05 volt and even such small generator output will be visible. On a 5-inch scope face the calibrating voltage is 4½ inches high if each ⅛ inch equals 0.05 volt peak-to-peak.

Some signal generators used in TV service have an output of 1 volt (r.m.s.) across 50 ohms while others have 0.1 volt or 100,000 microvolts, as nominal output amplitude. In each instance the method of measurement will determine the actual reading. If a

By **WALTER H. BUCHSBAUM**
Television Consultant, RADIO & TV NEWS

generator has less than 0.05 volt peak output, its utility for service work is so reduced that repair is indicated.

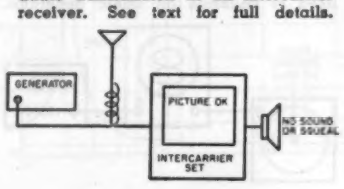
Many generators have an output amplitude control associated with the r.f. output network. In the more elaborate units this takes the form of a variable coupling attenuator. Many other generators use a simple potentiometer which varies the "B+" or the cathode bias of some stage. Defective controls can result in insufficient or no output but this is usually easy to check. When the output control appears to have insufficient effect in reducing the output, however, some other part may be at fault. Occasionally a broken ground lead inside the generator reduces the shielding or filtering effect of some component so that the radiation from the a.c. power cord, for example, is sufficient to drive a receiver even when the output control is turned to minimum. To find radiation trouble a sensitive receiver and a small loop antenna are needed and this type of defect is usually better handled by the manufacturer or test equipment specialist.

Intermittent defects in a signal generator originate in the same manner as intermittents in all electronic equipment. They are equally difficult to find and require patience and luck. The most frequent causes are intermittent tubes, capacitors, variable capacitor plates bending and shorting, and poor grounding.

In addition to having sufficient output, a signal generator must also be reasonably accurate in its frequency reading. It should be recognized here that any variable frequency oscillator will have problems of "resettability," backlash, age and heat drift, and tube variations. Manufacturer's specifications, such as 1% accuracy, simply mean that if the dial reads 176 mc. and the generator is operating on the fundamental, the actual operating frequency may be anywhere from 174.24 to 177.76 megacycles. The range can be computed for other fundamentals.

It is apparent that for the alignment of a TV receiver such accuracy is inadequate since the difference could mean that channel 7 is received with sound in the picture or *vice versa*. For that reason crystal-controlled markers or calibrating oscillators are used. Many of the latest type signal generators contain built-in crystal markers, usually at some convenient frequency.

Fig. 2. Generators may be accurately calibrated to TV frequencies by zero-beating the instrument against a TV audio transmission in an intercarrier receiver. See text for full details.



A crystal oscillator is much more accurate, often as close as 0.001%. To use the crystal calibration at any frequency one can zero-beat the crystal and the variable oscillator at some multiple of the crystal frequency and then judge frequency from there. For example, in the case of the *Hickock* Model 288X there is a 100 kc. and a 1 mc. crystal beat available. If 41.25 mc. is to be checked, the generator is tuned to approximately 41 mc. and the 1 mc. crystal is selected. The output is connected to a diode probe and audio amplifier. Then the frequency dial is moved slightly until first a beat note, then a null, and another beat is heard. Now the generator frequency is 41 mc. With the crystal oscillator switched to 100 kc. advance the frequency dial until two zero-beats are reached and the frequency is 41.2 mc. Advance the dial to the third beat, 41.3 mc., and move it back halfway between the position of the 41.2 and the 41.3 mc. zero-beat. This method produces considerable accuracy and is widely used for aligning TV receivers.

Where built-in crystals are not available, external crystal sources can be used. Typical of these is the *Wintronix* Crystal Calibrator Model 120 for service use. This is an inexpensive crystal oscillator with a built-in crystal for 3.579 mc., the color subcarrier frequency. To obtain other frequencies there are three external jacks into which any crystal from 100 kc. to 15 mc. can be plugged. A simple attenuator permits variation of the output amplitude to avoid overloading. It is also possible to build a crystal oscillator in the shop using one of the circuits found in tube and transistor data sheets, amateur handbooks, and other sources.

When no suitable crystal source is at hand, there are still many ways in which frequency can be checked accurately. All radio stations are required to keep the transmitting frequency to very close tolerances and it is only necessary to know what this frequency is to use it as a standard for calibrating a signal generator. A frequently used system in TV servicing can be presented as an example. Assume that we wish to calibrate a signal generator at channel 7 and that a TV station can be received locally at that channel. If an intercarrier receiver is used, the arrangement in Fig. 2 will apply. The sound frequency for channel 7 is 179.75 mc. and this is mixed with the video carrier to produce the 4.5 mc. intercarrier sound i.f. which is frequency modulated. The signal generator is best set for c.w. or unmodulated output and tuned for approximately 179 mc. Its output can be coupled to the TV antenna by wrapping a few turns of wire around the twin-lead near the antenna terminals. Now vary the generator frequency carefully until there is a distinct garbling of the sound. When the frequencies coincide sound will still be heard since the station signal is frequency modulated over ±25 kc.

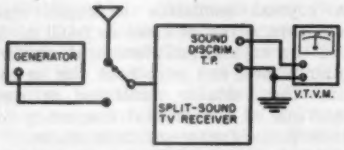


Fig. 3. Improved calibration accuracy is possible with a split-sound receiver.

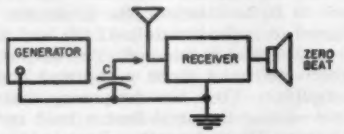


Fig. 4. Calibration at broadcast frequencies is obtained by beating generator output against reception on AM set.

Actually it is possible to observe the exact zero-beat by the fact that the distortion is not audible but if the generator dial is moved either way, garbled sound is apparent. A variation of this method requires that the TV set is accurately aligned and the ratio detector output be measured at the a.v.c. point. Then the generator can be tuned for minimum a.v.c. corresponding to zero beating the sound carrier.

When calibrating a generator with an intercarrier set it should be kept in mind that a strong signal from the generator coming in 4.5 mc. below the video carrier will also produce a similar beat. The generator is first set to 170 mc. and then advanced to the beat at 170.75 mc. Next the generator frequency is tuned through the 175.25 video carrier, with its effect visible on the screen, and finally through the correct 179.75 point. Calibration can be checked at each of those points, but only the latter point should be considered accurate. Another factor to keep in mind is the frequent use of second or third harmonics as signals for the higher TV band. In our example, if the third harmonic is used, the calibration at the same time provides a reasonably valid check for 59.92 mc.

If, instead of an intercarrier receiver, a split-sound type is used, the sound i.f. channel may have to be aligned carefully first. In most sets of this type when the picture has full definition and the sound appears clear and undistorted, the sound channel or at least the discriminator can be considered to be correctly aligned. Fig. 3 shows a typical arrangement using the v.t.v.m. connected across the discriminator output and set for center zero reading. As described for the intercarrier set, both a signal 4.5 mc. higher and 4.5 mc. lower than the video carrier will be received. With the split-sound type set, the most accurate way to calibrate is to receive the station first, tune for perfect sound and proper picture. Then disconnect the antenna, feed in the signal generator output and tune it for zero indication on the v.t.v.m. This is more accurate and more reliable than the "zero-beat" with the intercarrier receiver.

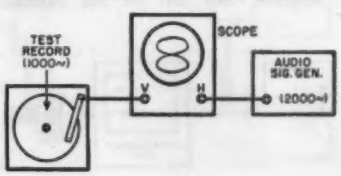
With either kind of set it is possible to receive a strong signal from the signal generator at a frequency twice the i.f. away from the actual frequency. Most TV sets have the local oscillator set 21 or 41 mc. above the incoming station frequency and therefore will accept a very strong signal 42 or 82 mc. above the regular station. If a set is tuned to channel 2, for example, and has a 41 mc. i.f. system, then it is possible to calibrate a generator at 141.75 mc. It may be necessary to feed this image signal directly into the antenna terminals at maximum generator output level. By applying some simple arithmetic and ingenuity to the frequencies of locally available TV stations, many different frequency points can be calibrated.

For the broadcast band a standard broadcast receiver can be used and the simple, audible zero-beat method will do fine. Local newspapers usually list station frequencies, but when this is not exact enough it may be worthwhile to phone the station for the information. Fig. 4 shows a simple coupling capacitor, usually about 1000 $\mu\mu$fd., used to feed the signal generator output to the antenna terminals. In order to get accuracy the signal generator output amplitude should be set low enough so that the station is not completely blotted out with the exception of zero-beat.

Above the broadcast band a communications receiver is needed and in order to get accurate frequency data the National Bureau of Standards station WWV can be tuned in. This transmits signals at 2.5, 5, 10, 15, 20, 25, 30, and 35 mc. modulated at 440 cps and 600 cps and easily identifiable because of their frequent timing signals and station identification. The transmissions from 5 to 20 mc. are usually received strongest and should be available in almost every part of the country.

Some service shops have audio generators, especially where the hi-fi business counts, and frequency calibration of the generator is important at least at some test frequencies. A simple method for this job makes use of a turntable, test record, and oscilloscope. As shown in Fig. 5, the output of the test record is applied directly from the pickup or preamplifier to the vertical scope input while the generator is connected to the horizontal scope input. When the test record produces 1000 cps and the generator is tuned to exactly the same frequency, it will be possible to obtain a single circle on the scope. If the generator is tuned to 2000 cps, a figure-8 will appear. A whole series of Lissajous patterns can be obtained by beating with multiples of a test record frequency. If real accuracy is required it may be worthwhile to check the speed of the turntable by putting on a test disc with stroboscopic pattern and observing it under a fluorescent light. The pattern designed for the particular turntable speed will appear to stand still if the speed is exactly right. Once the turntable speed is established, the test frequency will always be right. Poor response from the pickup can reduce the amplitude or introduce harmonics, but the basic frequency is unchanged. (Note: If a communications receiver is available, the standard audio tones produced by WWV can provide reference frequencies that may be used to produce Lissajous figures. Also the closely regulated 60-cps power line frequency may be used for this purpose.)

Fig. 5. A frequency test record may be used to calibrate an audio generator.



Frequency Table

In some generators provision is made for over-all calibration to make the dial track, usually at two points, with the actual frequencies. Such adjustments should be made before any other calibration is undertaken. Once the dial is set correctly at the specified points, however, the remaining frequencies should be checked and if they are more than 1% off, calibration data should be kept.

A few generators have blank dial bands which the owner can use to mark frequencies directly as his calibration process establishes them. On most generators, however, a frequency scale is permanently engraved or printed and should not be disturbed. To mark corrected frequency, a separate record is made, either in the form of a graph or a table. For some lab work graphs are preferred but in a service shop, a table is handier. Usually the table has two columns, one listing the dial reading and the other the actual frequency.

In making up such a table from rough notes taken during the calibration process, it is a good idea to underline frequencies most often required. It is possible, within limits, to interpolate results and put this information right on the table. If, for example, the dial reads 178 mc. at the actual 179.75 mc. and 198 at 199.75 mc., it is reasonable to assume that it will read 188 when it is really 189.75 mc. Similarly, other frequencies between two calibration points can be interpolated. The actual calibration points should then be underscored or marked in another color.

The completed calibration table should be clearly lettered or typed and sealed between plastic covers. Or the paper may be sprayed several times with acrylic (*Krylon*) or pasted on cardboard and covered with Cellophane. Some means of keeping calibration data in permanent, legible form is helpful and, if possible, the data should be tied directly to the generator. —30—

All About Audio and Hi-Fi

Electrostatic Speakers & Transient Response

By G. A. BRIGGS
Managing Director
Wharfedale Wireless Works Ltd.

Part 6. Matching electrostatic tweeters to amplifiers, and factors that affect transient response of speakers.

THE question of load matching between amplifiers and electrostatic speakers is rather involved and the problems are not yet generally understood. Mr. R. E. Cooke, our technical director, has been making an investigation into what happens, and I do not mind admitting that I read his findings *in statu pupillari* (as a student); he admits with becoming modesty that he learned quite a bit himself. Here is the report in Mr. Cooke's own words. (As this is the sixth article in the series, it is time he showed his hand.)

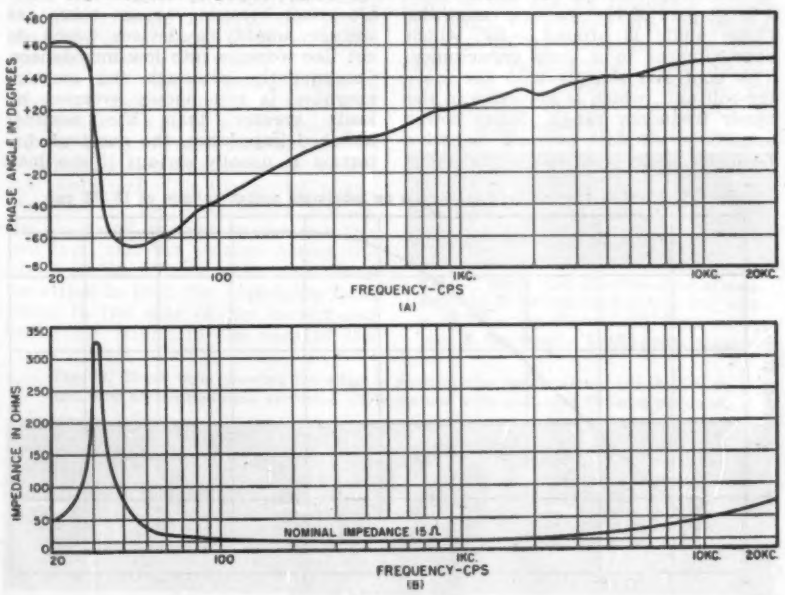
For the sake of simplicity we usually refer to impedance by its numerical value alone, but, as the term implies, we are really dealing with a complex mixture of resistance and reactance. Reactance is the technical term for the blocking action due to an inductor or capacitor and the amount of reactance associated with a given impedance is often expressed as a phase angle. The sign of the phase angle, *i.e.*, plus or minus, indicates whether the reactance is inductive or capacitive in nature, as the case may be.

For the purpose of simple discussion we can say that a phase angle of +90° corresponds to pure inductance and −90° corresponds to pure capacitance, while zero angle indicates pure resistance. Intermediate values relate to mixtures of resistance and reactance which may be inductive (positive) or capacitive (negative) in character.

Fig. 23 shows the phase angle and impedance characteristics of a 10" moving-coil loudspeaker with foam suspension when mounted on a plane baffle 2½ feet square. The measurements were carried out using a *Muirhead* impedance and phase angle meter Type D-728A in conjunction with a b.f.o. and standard resistance box. The impedance curve is quite ordinary and shows the usual peak at the fundamental resonance frequency, with a gradual rise above 400 cps due to voice-coil inductance. The phase angle curve is relatively unfamiliar, however, and shows that this typical unit behaves like a pure resistive load at two frequencies only. The lower one corresponds to the fundamental resonance at 31 cps, and the upper frequency is 300 cps which occurs in the region of the lowest impedance value normally used for matching purposes. Between these two frequencies the loudspeaker is capacitive in its behaviour, while outside that region it behaves inductively.

We know from experience that most

Fig. 23. Phase angle and impedance of 10" moving-coil speaker on a flat baffle.



with the intercarrier receiver.

generator.

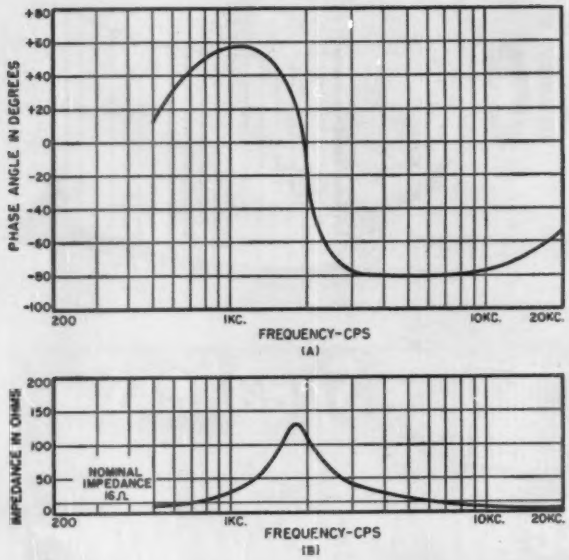


Fig. 24. Here are shown the phase angle (upper curve) and the impedance (lower curve) of a push-pull electrostatic tweeter. Note that, as is to be expected, phase angle is on the order of — 80 degrees, which approximates a purely capacitive circuit.

power amplifiers are quite happy when feeding loads of this type but it is generally accepted that electrostatic speakers present some new load matching problems; so we cannot do better than start by inspecting the phase-angle and impedance curves of a typical push-pull electrostatic tweeter of the latest type.

These are shown in Fig. 24, and we can see at once that electrostatics behave quite differently from moving coils. This particular electrostatic unit contains a built-in high-pass filter incorporating an inductor, which accounts for the peak in the impedance curve as well as for the positive phase angle below 2000 cps. Although the operating range is from 500 cps upwards, the interesting part of the curves is in the region above 3000 cps, where the impedance falls rapidly to 5 ohms at 15,000 cps although the unit is nominally rated at 16 ohms. Over a large part of the working range the phase angle is around —80° which approximates to a pure capacitance. This contrasts sharply with the moving-coil unit, which is inductive in the upper frequency range. Many power amplifiers employ over-all negative feedback taken from the secondary of the output transformer. The loudspeaker load is therefore included as part of the feedback loop and its phase characteristics must be taken into account. In order to maintain stability, the phase of the feedback voltage must remain within certain limits and some amplifiers which have been designed to work with moving-coil loudspeakers may become unstable when faced with electrostatics.

However, there is no fundamental difficulty in building an amplifier which will remain stable while feeding this type of load and in course of time all high-quality power amplifiers will be designed with such operating conditions in view.

The real snag in matching an electrostatic loudspeaker to its driving amplifier is the problem of developing an adequate voltage across the loudspeaker terminals over the whole operating frequency range. The trouble arises because vacuum tubes are voltage amplifying devices which do not like working into low impedances. Consequently, although the average amplifier is not unduly worried by loads greater than the nominal matched impedance, the onset of distortion is usually serious if the load impedance falls very much below the nominal matched value, and the same power output is expected.

In order to obtain some factual information, tests were carried out on a good quality power amplifier of reputable vintage. Its power output was rated at 12 watts and its nominal matching impedance was 16 ohms. Fig. 25 shows the effect of varying load resistance on the maximum output voltage at 15,000 cps. Similar results were obtained at other frequencies in the working range; 15,000 cps was adopted here because we happen to be interested in high-frequency performance for purposes of this discussion. The curve shows that the maximum voltage available, just short of clipping, falls away drastically as load resistance is reduced. For example, with a resistance of 5 ohms only 4.5 volts were available as compared with 15 volts across 16 ohms, corresponding to a drop of 10.5 db in maximum output voltage. In other words, when faced with a load resistance of 5 ohms the output of this amplifier is only equivalent to 1¼ watts related to its matching impedance of 16 ohms.

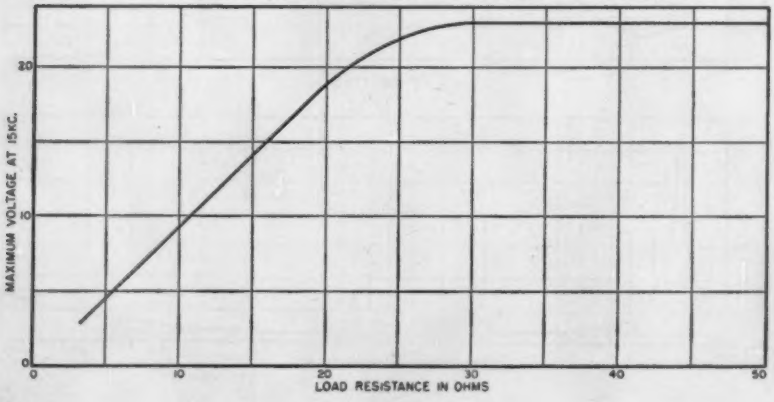
Fortunately, most practical amplifiers seem to have a slightly better performance as regards distortion and overload when working into reactive loads, and it appears that the resistance load is the worst case. When the electrostatic unit was connected to the amplifier used for the previous test, a maximum voltage of 5.7 was obtainable at 15,000 cps which, although better than the 4.5 volts obtained with a resistive load of the same value (5 ohms), is still 9 db below 15 volts.

This drop of 9 db does not mean that the output will be 9 db down at 15,000 cps during normal operating conditions. What it does mean is that this particular amplifier/loudspeaker combination will handle 9 db less input at 15,000 cps without distortion, relative to the mid-range input.

Thus if the amplifier is fed with a 15,000 cps signal and the level gradually increased, it is obvious that distortion will occur earlier than would have been the case with a load impedance of 16 ohms or more. The position could of course be eased by treating the loudspeaker as a 5-ohm unit and rematching with a suitable transformer, but this would result in a loss of sensitivity amounting to 5 db which would be unacceptable, especially in view of the fact that the electrostatic unit is already less sensitive than high-flux, moving-coil types.

Full-range electrostatic loudspeakers behave in a similar fashion at high frequencies, but the impedance can be prevented from rising too severely at middle frequencies by crossing over to an electrostatic bass section at a carefully chosen point. Clever circuit design also helps matters here, an artifice not open to the tweeter manufacturer because he has no control over the type of bass speaker with which

Fig. 25. Effect of varying load resistance on maximum output voltage at 15,000 cps.



his unit may ultimately have to work.

As the frequency goes down, the impedance continues to rise, as one would expect with a capacitive device. In a typical case the impedance of a nominal 15-ohm electrostatic unit reaches 30 ohms at 40 cps. This is actually a benefit because the electrostatic is a voltage-operated device and the rising impedance insures that the amplifier can maintain its drive down to the lowest frequencies. On the other hand, the operation of a moving-coil speaker depends upon current, so that an impedance rise at low frequencies results in more difficult conditions for bass reproduction.

The question which now arises is whether this falling high-frequency impedance will cause the amplifier to run into distortion on speech and music, and here the usual crop of *if's* and *but's* begins to sprout. Certainly there is a tremendous amount of energy in sounds such as a cymbal crash, which make heavy demands upon the power amplifier, especially if recorded out of balance and reproduced at high level. It is therefore likely that electrostatic speakers will require the use of amplifiers in excess of 15 watts' rating if full-blooded reproduction is required. This increase in power is necessitated partly by the lower sensitivity of current electrostatic designs as compared with moving-coil types and partly by the mismatch referred to previously. It seems likely that 30-50 watt amplifiers will become more common as the electrostatic era dawns and develops.

Now that we have reached the subject of loudspeaker watts, this seems a good place to point out a few common fallacies. With the moving-coil loudspeaker most of our calculations are based on the nominal impedance at around 300-400 cps where we see from Fig. 23, the load is almost a pure resistance. In these circumstances it is permissible to calculate the power absorbed by the speaker from the formula:

$$Power = \frac{V^2}{Z} \quad watts$$

where: V = voltage across voice coil
Z = loudspeaker impedance in ohms.

Thus in the case of the unit of Fig. 23, for 4 volts across the voice coil the power input would be:

$$\frac{4^2}{15} = 1.07 \ watts$$

At all other frequencies, variations in impedance and phase angle must be taken into account by inserting phase angle into the formula, thus:

$$Power = \frac{V^2 \cos \phi}{Z} \quad watts$$

where: ϕ is the phase angle.

Hence for the same 4 volts at 31 cps, the power input has fallen to 0.05 watt. Although the power input to the unit has fallen so drastically, it must be remembered that the efficiency has increased enormously, due to the fundamental resonance which occurs at 31 cps. The actual sound power output is therefore maintained to a great extent. Similarly, at 15,000 cps the input power is 0.16 watt, but here there is no resonance to boost efficiency so that the output falls accordingly. (Hence the importance of avoiding the impedance rise as much as possible, as already pointed out in Part 5.)

It is interesting to look at the electrostatic tweeter from the point of view of power absorbed for the same input of 4 volts. At 1950 cps where the phase angle is zero, the power absorbed is ⅛ watt, while at 15,000 cps the power is 1¼ watts.

These few figures should suffice to show how meaningless it is to talk of loudspeaker watts by merely considering voltage and rated impedance.

Generally speaking, however, we are not concerned with the actual power absorbed by the loudspeaker, but by the voice-coil current in the moving-coil type and the voltage across the plates in the electrostatic type. Thus we strive to keep the impedance from rising in the case of the moving-coil and from falling in the case of the electrostatic. With typical contrariness, nature opposes our efforts.

Here ends the first lesson by Mr. Cooke.

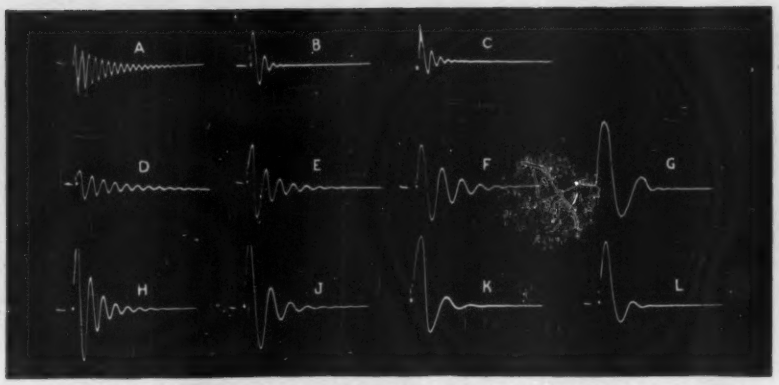


Fig. 26. Actual photographs of oscilloscope records of the shock effect on various speaker/cone/coil/magnet assemblies. (A) A 6-inch unit with low flux density, corrugated cone suspension. Note "ringing" with exponential decay rate and 22 vibrations before cone comes to rest. (B) A 5-inch unit with high flux density, cloth suspension, and a finer spider. Note big improvement over part A. Input at 0.5 volt. (C) Same as part B, but magnet reduced from 13,000 gauss to 5000. Note the 7 or 8 oscillations instead of the previous 4 or 5. Input increased to 1.5 volts to make up for the loss of sensitivity. (D) An 8-inch speaker with 8000-gauss magnet. A corrugated cone suspension is used. (E) Same as for part D but speaker uses an 13,000-gauss magnet. Note the greater sensitivity and better damping shown by the rapid rate of decay, with fewer oscillations. (F) Same as for part E but with cloth suspension, which lowers the frequency of the cone resonance and, in addition, reduces the number of vibrations. (G) Goodmans 8-inch unit with free-edge cone and saturated pole. Low resonance frequency and rapid decay rate is shown. (Note: The unit was referred to in previous article.) (H) A typical 12-inch unit with corrugated cone and a 13,000-gauss magnet. (J) Same as for part H but with cloth surround. Note the obvious improvement. (K) Same as for part J but magnet improved to 17,000 gauss. Again there is an obvious improvement. (L) A 15-inch unit with a large magnet. There is little or no ringing here.

Transient Response & Resonances

These qualities are taken together because one is dependent on the other. Absence of resonance (or ringing) *ipso facto* results in good transient response provided a sufficiently wide frequency range is covered.

The basic difference between a loudspeaker and a musical instrument is that in the one all resonance should, in theory, be avoided like the plague, whereas in the other maximum resonance is the objective. Piano makers strain at the leash to increase the effectiveness of the soundboard or

(*Continued on page* 106)

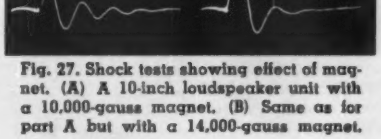
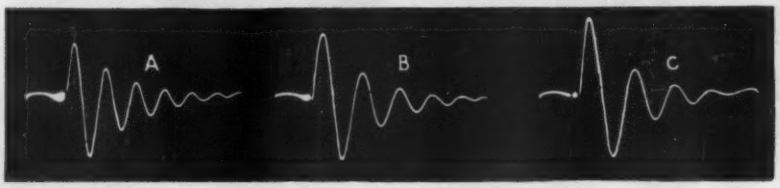
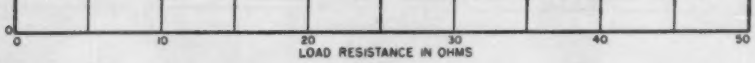


Fig. 27. Shock tests showing effect of magnet. (A) A 10-inch loudspeaker unit with a 10,000-gauss magnet. (B) Same as for part A but with a 14,000-gauss magnet.

Fig. 28. Shock tests showing the effect of various cone suspensions. (A) A 10-inch unit with corrugated cone surround. (B) Same unit with cloth and (C) foam surround.





lice not open to the tweeter manufacturer because he has no control over the type of bass speaker with which

Why Service Associations?

By **WILLIAM LEONARD**

Intelligent competition and continued survival of independent service depend on them, in one view.

SEVERAL years ago, in an article titled "Trade Associations, Key to Intelligent Competition," the Honorable Raymond Blattenberger said, "Business has found that the collective intelligence of a group is greater than the intelligence of any one of the individuals. Unity of purpose and unity of action will carry an industry farther than almost any amount of individual effort."

The electronic service industry has covered a good many rough miles of going since TV launched it into the realm of big business a decade ago. It passed through an era when it was a business bonanza for any aggressive TV technician who had a yen for a business of his own. The ease with which any alert, ingenious technician could make money out of TV service spawned some very bad business practices that are now starting to spill a lot of trouble into the laps of all electronic service dealers.

It can be safely said that more than 99% of the people who operate independent service businesses are fundamentally honest men. Their ambition is to give the best possible service and, of course, they hope for a better-than-average return from their efforts.

Unfortunately, the bad business practices that were woven into the fabric of TV service during the boom days, when the service industry was being formed, have carried over into the lean years. They serve as millstones around the necks of the men who are struggling to bring a measure of long-range stability into their own businesses.

These bad business practices are so deeply rooted and so insidious that many service dealers are looking frantically for outside assistance to correct them, even to the point of turning control of the industry over to politicians. To date it has been a fruitless battle because the elimination of most of the real troubles that weigh heavily on independent service shops can be corrected only by the members of the service industry itself.

There is an old truism to the effect that "anything worth having is worth fighting for." The major barrier in the path of independent service has been that service dealers spend the bulk of their time and effort fighting each other, instead of pooling their efforts in a common program to build prestige for their businesses in the eyes of their ultimate employers—the public.

In order to work harmoniously together in programs for their common good, service dealers must get acquainted—must know each other. In our society, this is accomplished through formal trade associations. By means of by-laws and codes of ethics, associations provide a solid foundation on which men of integrity can work together to build an industry.

In recent years, the most successful service associations have been those that are primarily concerned with electronic service as a business. While members continue to maintain a healthy interest in the changing technology of equipment and service, their association efforts are directed toward creating a healthier business atmosphere for all honest independent electronic service dealers.

When service dealers get to know each other through their regular association meetings, they soon discover that the major problems of any one of them are the major problems of all. Every man gains something in the exchange of information and ideas. Differences of opinion are resolved through frank, open discussions and the over-all gain is a steady rising of the business operating methods of all active members of the association.

Service dealers who work together in an association learn to respect each other. Since the public will not respect an industry whose members have no respect for each other, the fellowship of service businessmen working together in an association will help to eliminate the petty back-biting that has been a cancer in the side of the service industry for many years.

We live in a dynamic era of constant, relentless change. The neighborhood grocery store that existed on "standard mark-ups" has been steamrollered out of business by the fabulous super-markets that prosper on inventory turn-over. The once all-important prescription department in drug stores is now a sideline in modern drug-variety stores. But there are still thousands of independent grocers and druggists who own and operate prosperous businesses. They have matched the progress of chain and super-market development through the help of their own independent trade associations—men working together in programs for their common good.

The specter of factory-controlled service hovers over the independent electronic service industry. A nationally known brand name inspires confidence. Independent service can put its collective weight behind a brand name of its own on a national scale. But it will require cooperation in all forty-eight states through the medium of local and state service associations.

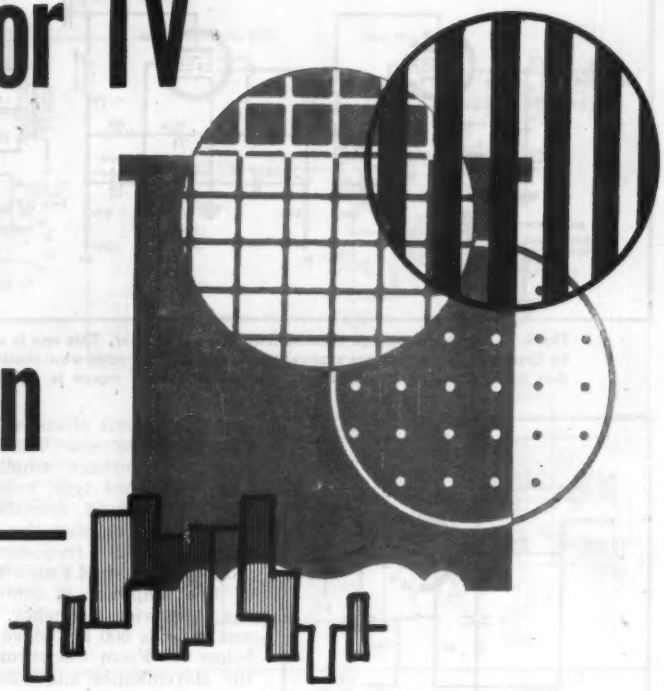
The electronic industry holds a glowing future for independent service dealers *if* they are wise enough to join forces and cooperate from coast-to-coast in programs that are for their common good.

The first and biggest problem the service industry must tackle is that of building customer good-will and respect for members of the independent electronic service industry. It must work hard to wipe out the suspicion and distrust of the average set owner when he calls an independent service dealer. This job must be done by the independent service industry itself working cooperatively in local, state, and national associations. It is not the responsibility of the set or compo-

(*Continued on page* 168)

ciency has increased enormously, due

Practical Color TV For The Technician



By **KEN KLEIDON**
National Color TV Manager
Hycon Electronics

Part 3. Eight typical color-processing circuits, from the same number of different color receivers.

OF THE FOUR areas of interest to the service technician, the nature of the transmitted color signal has already been discussed. In connection with this signal, some preliminary consideration of the receiver circuits involved with it were inevitable. In this article, a more extensive treatment of these circuits will be attempted.

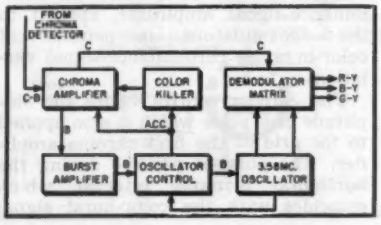
As we have said earlier, the color circuits are those which process only that portion of the total transmitted signal which pertains to color information. Also by way of recapitulation, these signals are the color-burst and chrominance signals. Since this type of signal information differs from the more familiar video information and synchronizing pulses associated with monochrome TV, the types of circuits used for processing these color signals will also be on the unfamiliar side. However, an over-all appreciation of their function and operation is a necessary prelude to signal tracing, analysis of circuit failures, and other techniques of troubleshooting.

Fig. 1 is a block diagram of the color circuitry of a typical 1957 color receiver. The three lower blocks—burst amplifier, oscillator control, and 3.58-mc. oscillator—represent the color-reference subcarrier oscillator and synchronizing circuitry. The remaining blocks represent the chroma circuits. The six blocks illustrate the basic functions which must be incorporated in every color receiver. Fig. 1 represents only one of the specific circuit arrangements that may be used to accomplish these basic functions.

Every color receiver will contain an oscillator operating at 3.58-mc., which supplies two subcarrier reference signals to the demodulators. Also, circuitry to control the phase and frequency of the color oscillator will be included, along with a circuit for separating the color-burst signal for synchronization. A chroma amplifier will be required to select and amplify the chrominance signal, as well as two demodulators to detect the chrominance signal. A matrix circuit will also be required to develop the third color-difference signal and a color-killer stage will usually be provided to disable the chroma circuits during monochrome reception.

(EDITOR'S NOTE: *Color-killer stages were omitted in some early designs in which it was necessary to manipulate the chroma control manually in order to avoid color contamination of a monochrome picture. Omission of this stage in more recent designs does not mean the same thing however. In some receivers the color circuits are only operative when made so by incoming color signals. Therefore, they do not require de-activation during monochrome reception, and the killer is unnecessary. For example, see details of a G-E color receiver on page 66 of our May, 1957 issue.)*

Fig. 1. This block diagram characterizes the type of color receiver circuit produced and sold during this past year.



As shown in Fig. 1, the chrominance and color-burst signals are applied from the chroma detector to the chroma amplifier. Both signals are amplified and the chroma (*C*) signal is applied to the demodulators while the color-burst (*B*) signal is coupled to the burst amplifier. The burst amplifier separates the color burst from the chrominance signal and also amplifies the color burst before coupling it to the oscillator-control circuit. The oscillator-control circuit compares the 3.58-mc. oscillator signal with that of the color-burst signal and provides a correction voltage for the oscillator, when a difference occurs, to assure synchronization. The 3.58-mc. oscillator generates two subcarrier reference signals which are applied to the demodulators.

The demodulators receive the reference signals from the 3.58-mc. oscillator and the chrominance signal from the chroma amplifier. The chrominance signal is demodulated or detected, and two color-difference signals are then obtained. The third color-difference signal is derived through the matrix circuit by mixing together the two color-difference signals ob-

days, when the service industry was being formed, have carried over into the lean years. They serve as mill-

together to build an industry.

In recent years, the most successful service associations have been those

and national associations. It is not the responsibility of the set or compo-

(*Continued on page* 168)

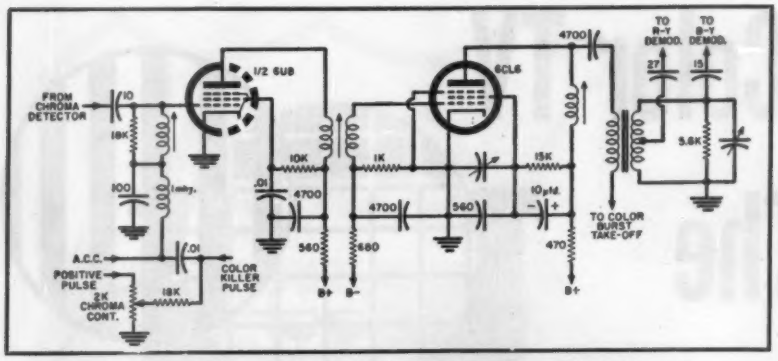


Fig. 2. A typical two-stage chroma (bandpass) amplifier. This one is used by Emerson. The stages are stagger-tuned in a manner somewhat similar to that used in video i.f. amplifiers, but the frequency range is different.

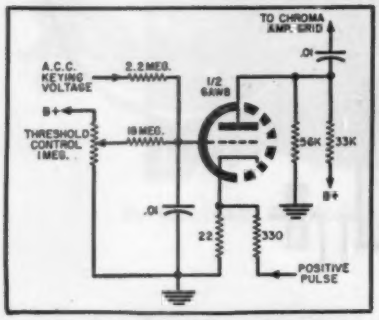


Fig. 3. RCA uses this color-killer circuit. During monochrome reception, output from this tube cuts off the chroma amplifiers, preventing color output from these stages.

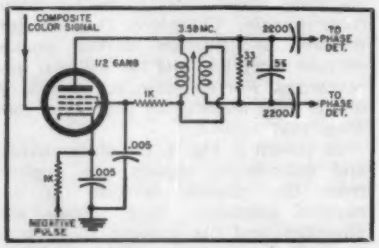


Fig. 4. A keyed amplifier (Admiral) separates the burst from the composite color signal and applies it to the color phase detector for sync.

tained from the demodulators, in the proper proportions. The three color-difference signals (*R-Y, B-Y,* and *G-Y*) are then coupled to the appropriate control grids of the color picture tube.

Basic stages and circuits involved in the process just outlined are presented in Figs. 2 through 8. These seven circuits have been extracted from the receivers of seven different manufacturers. Although variations do occur, each circuit chosen is a popular one which generally represents its counterpart in other receivers. Once basic function is understood, differences from one manufacturer to another—except in those rare cases where radical design differences occur—will not present any great difficulties in servicing.

Fig. 2 is the chroma (or bandpass) amplifier circuit of one color receiver, made by *Emerson*. This circuit employs a two-stage amplifier of the staggered-tuned type, somewhat similar to a video i.f. amplifier, the only difference being that the chroma amplifier handles frequencies in the vicinity of 3.1 to 4.1 mc. The response of this amplifier is centered around the subcarrier frequency of 3.58 mc., and extends 500 kc. above and 500 kc. below it. From the chroma detector, the chrominance and color-burst signals are both amplified by the chroma amplifier. In the output of the second chroma amplifier, the color-burst signal is separated and the chrominance signal is applied to the demodulators.

As shown in Fig. 2, three signals are coupled to the grid of the first chroma amplifier: a.c.c., color-killer pulse, and chroma-control pulse. The a.c.c. (automatic chrominance control) is applied in the form of a negative bias voltage coupled from the oscillator-control circuit. The negative bias voltage is dependent on the color-burst signal amplitude. If the chrominance signal, which includes the color burst, is reduced in amplitude for any reason, the amplitude of the color-burst signal is reduced accordingly and consequently the negative a.c.c. output of the oscillator-control circuit is reduced. The negative bias voltage applied to the grid of the first chroma amplifier thus also becomes less, thereby permitting more gain in this amplifier.

Conversely, for an increase in chrominance signal amplitude, the bias will increase to reduce the chroma amplifier's gain. The a.c.c. circuit is similar in operation to an a.g.c. circuit. In the same way that an a.g.c. circuit maintains a relatively constant detector output signal amplitude, independent of signal variations, the a.c.c. circuit maintains a relatively constant chrominance-signal amplitude, applied to the demodulators, independent of color-burst or chrominance-signal variations.

The chroma control varies the amplitude of a pulse which is also applied to the grid of the first chroma amplifier. The pulse is positive during the horizontal blanking interval, which coincides with the color-burst signal transmission period. This pulse also influences the gain of the chroma amplifier during that period.

Also shown coupled to the grid of the first chroma amplifier is a color-killer pulse. The pulse is coupled from the color-killer stage, illustrated in Fig. 3, which is simply an automatic circuit used to disable the chroma amplifier during monochrome reception. This specific circuit is used in some *RCA* sets. The color killer prevents spurious signals from being passed by the chroma amplifier and appearing superimposed over the monochrome picture. During color reception, the color-burst signal, present in the transmission, develops a high negative a.c.c. voltage which is coupled to the grid of the color-killer stage. This negative keying voltage is sufficient to prevent the color-killer stage from conducting.

During monochrome reception, the color-burst signal is absent and the a.c.c. keying voltage is reduced considerably, allowing the color-killer stage to operate. A positive pulse, during the horizontal blanking interval, is applied to the cathode of the color killer, as shown in Fig. 3. The color killer amplifies the pulse, which is then coupled to the grid of the chroma amplifier. Here a negative voltage derived from this pulse prevents the chroma amplifier stage from conducting during the line interval or retrace period. A threshold control is provided for precise adjustment of the operating point of the circuit.

The color-burst signal, depending on the design of the receiver, may or may not be amplified by the chroma amplifier. In any case, however, the color-burst signal must be separated from the chrominance signal and applied to the color oscillator for synchronization. This separation is usually accomplished by a burst amplifier (burst gate or burst keyer) circuit. The burst amplifier circuit of Fig. 4, used by *Admiral*, is designed to conduct only when the negative pulse is applied to its cathode, during the blanking period. This pulse reduces the grid-cathode bias sufficiently to allow conduction. Since the color-burst signal is transmitted during the blanking interval, it will be amplified, and output is developed across the 3.58-mc. tuned circuit in the plate, from which it is applied to the phase detector in the oscillator-control circuit.

The color-burst signal is then usually coupled to the color-phase detector (color-phase discriminator, burst-phase detector, or a.p.c.) circuit. The phase detector circuit (Fig. 5, after *Sentinel*) is similar to that of the horizontal oscillator control circuit in many black-and-white receivers. Two signals, 180 degrees out-of-phase, are coupled back from the color oscillator. The color-burst signal is also coupled to the phase detector. The color-burst signal is compared to the two feedback signals, and any phase difference results in a d.c. correction bias voltage, which is applied to the reactance tube.

oscillator operating at 3.58-mc., which supplies two subcarrier reference sig-

the matrix circuit by mixing together the two color-difference signals ob-

A comparison of Figs. 4 and 5 would, at first glance, seem to indicate some sort of discrepancy: Fig. 4 shows two color-burst signals, 180 degrees out-of-phase, being taken off from the burst amplifier for application to the phase detector, while Fig. 5 indicates that only one color-burst signal is applied to the phase detector. Actually, either arrangement is possible. If one thinks back to the phase detectors used for horizontal-oscillator control circuits in conventional monochrome receivers, it will be recalled that such variations are not uncommon.

In horizontal phase detectors where one sync pulse is applied, two feedback signals are also introduced from the horizontal-output stage; conversely, where two opposite-phase sync pulses are applied to the horizontal phase detector, they are compared with a single feedback signal. Similarly, two color-burst signals in opposite phase may be combined with one oscillator feedback signal in the color-phase detector, or two opposite-phase feedback signals may be combined with a single oscillator feedback signal. In Fig. 6, for example, only one oscillator feedback signal is shown as being coupled back to the phase detector.

The 3.58-mc. color subcarrier reference oscillator illustrated in Fig. 6, which is the particular one used in certain *Sylvania* color models, is held to correct phase and frequency by a reactance tube, not shown in the diagram. In this circuit, the d.c. correction voltage provided by the phase detector is fed to the reactance tube rather than directly to the oscillator. This arrangement, common in color receivers, is also found in the horizontal-control circuits of earlier monochrome receivers, in some of which it is known as the "Synchrolock" circuit.

The color subcarrier reference oscillator of Fig. 6, while it is locked by transmitted synchronizing information ultimately, is held close to the desired frequency by the 3.58-mc. control crystal in its grid circuit. It provides, as already noted, a feedback signal to the phase detector. It also provides two 3.58-mc. signals of different phase, taken off at different points in the output network, for application to the two

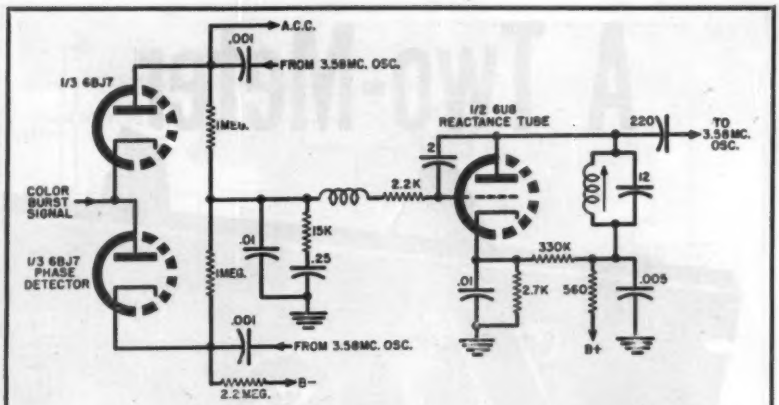


Fig. 5. (Above) A phase detector, like this one in a Sentinel receiver, regulates color sync.

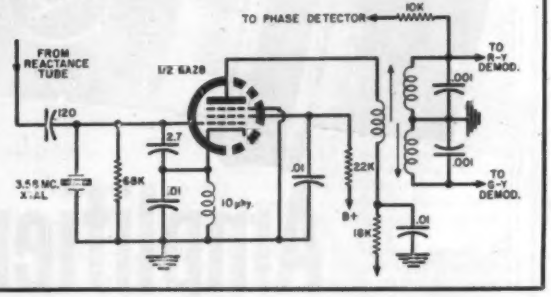


Fig. 6. (Right) This 3.58-mc. color subcarrier reference oscillator appears in a Sylvania color set.

demodulators. In this case, the oscillator's output transformer supplies two subcarrier reference signals that are 146 degrees out-of-phase. This is the phase difference used simply because, in transmission, *R-Y* and *G-Y* signals are 146 degrees apart.

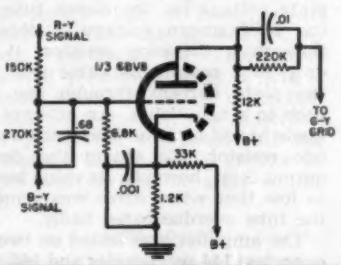
If *R-Y* and *B-Y* demodulators were used in the receiver, the phase difference between the two 3.58-mc. output signals from the oscillator would have to be 90 degrees apart, since that is the phase difference between *R-Y* and *B-Y* signals. If *I* and *Q* demodulators were used, the phase difference would also be 90 degrees. Actually, any two points may be chosen in the entire transmitted spectrum of chrominance information for the purpose of orientation to determine the positions of all other points. We would only have to make certain that the receiver is accurately adjusted to the actual phase difference between these two points as it exists during transmission.

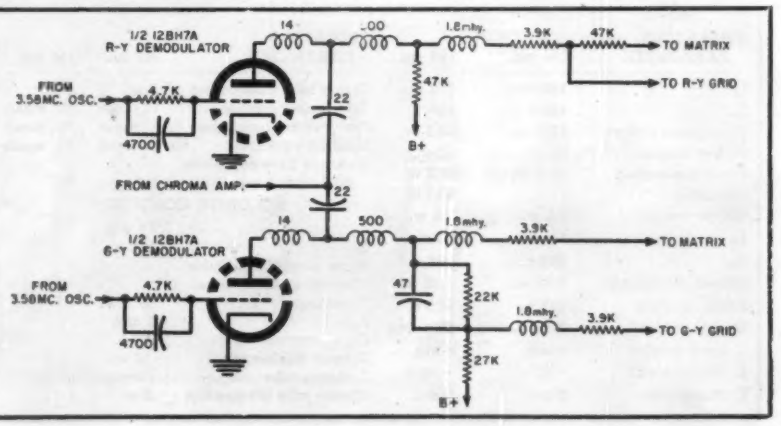
The *R-Y/G-Y* demodulator shown in Fig. 8 could work with an oscillator like that shown in Fig. 6. The pair of demodulators shown, however, are actually used in *Westinghouse* color sets. The chrominance signal, from the chroma amplifier, is coupled to the plate of each of the two demodulators. Up to a point, demodulator action is similar to that of the common amplitude-sensitive diode detector. However, if this were completely true, the output of both detectors would be identical. Actually, the presence of grids in these two detectors changes this operation somewhat: it provides the opportunity for gating the detectors; that is, turning them on and off at certain times. The two outputs from the oscillator, both at 3.58-mc. but each in a different phase, are introduced at these grids. Thus each de-

(*Continued on page* 173)

Fig. 8. (Right) The R-Y and G-Y demodulators are used by Westinghouse.

Fig. 7. (Below) A G-Y matrix amplifier, as found in a Motorola color receiver.

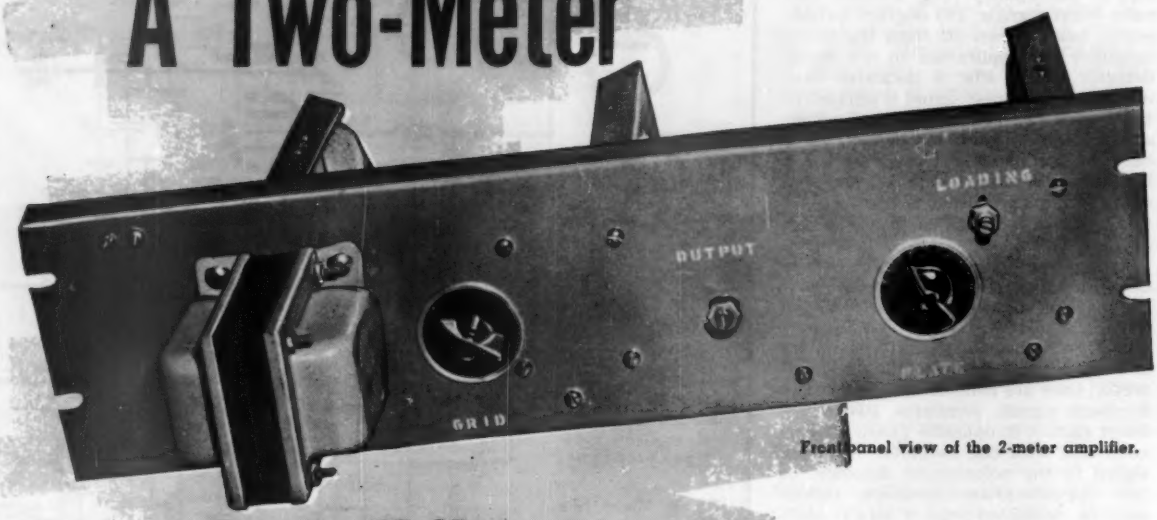




not present any great difficulties in servicing.

Fig. 2 is the chroma (or bandpass) fier. The pulse is positive during the horizontal blanking interval, which coincides with the color-burst signal signals, and any phase difference results in a d.c. correction bias voltage, which is applied to the reactance tube.

A Two-Meter Amplifier



Front panel view of the 2-meter amplifier.

By
HARDIN STRATMAN
Eng. Dept., Gates Radio Co.

Construction details on a v.h.f. amplifier covering 125-185 mc. with 60% efficiency, power gain of 20.

THE design of v.h.f. amplifiers poses no particular problem if the proper tube is chosen and care is used in the layout. The amplifier described was engineered by *Gates Radio Company* for 50 watts output. Required driving power is only 3 watts and neutralization is not necessary.

Construction

The input and output circuits are shielded from one another by a partition. This minimizes stray coupling between the output and input circuits. Several other techniques were also used to make this a "real live" amplifier. The important circuit connections and bypassing leads are of ½"-wide copper strap. This reduces inductance and places the screen, cathode, and filament at nearly ground potential.

The 5894 tube employs internal neutralization and is very stable. It has rather high input capacity which almost precludes the use of a parallel-tuned type of circuit at these frequencies. A series type of circuit works to advantage, however, because it utilizes lead inductance and makes for only one resonance in the grid circuit. This prevents oscillation at some spurious frequency. The plate circuit is conventional, parallel tuned. Using a grid dip meter, resonances other than the desired one may be found. Since none of these will coincide with identical frequencies in the grid circuit, the amplifier tends to be stable.

The output circuit is series tuned to ground and, in effect, "pulls out" every available watt. This technique works well with any r.f. amplifier and applies especially to those in the v.h.f. range.

To prevent over-dissipation of the 5894 amplifier tube when drive is removed, a clamp tube was used. When drive is applied to the 5894 tube, grid current will flow through the 15,000-ohm grid resistors and develop about −60 volts of bias from grid to ground. Part of this bias due to drive is applied to the 6AQ5 clamp tube and effectively cuts it off so that it draws almost no plate current. When drive fails, bias on the 6AQ5 and the amplifier tube will fall to zero and plate current in the clamp tube will rise. Since plate voltage for the clamp tube and the 5894 screen voltage is obtained through a dropping resistor, it will drop to a reasonable value and limit the plate current through the 5894 tube to a safe value. An attempt was made to self-bias the 5894 with a cathode resistor. To obtain the desired output level, however, its value became so low that when drive was removed, the tube overdissipated badly.

The amplifier was tested on two frequencies, 144 megacycles and 166 meg-

Table 1. Normal operating parameters of the two-meter v.h.f. power amplifier.

OPERATING PARAMETER	144 mc.	166 mc.
I_p	168 ma.	172 ma.
E_p	490 v.	490 v.
Plate input power	82.5 w.	84.5 w.
Power output	50 w.	51 w.
Plate dissipation	32.5 w.	33.5 w.
Efficiency	61%	60.5%
Driver power	2.5 w.	2.5 w.
I_{cg}	11 ma.	11 ma.
E_{cg}	168 v.	168 v.
Screen dissipation	1.85 w.	1.85 w.
Screen supply	325 v.	325 v.
Output control	Min. res.	Min. res.
I_g (each grid)	4 ma.	4 ma.
E_g (calculated)	−60 v.	−60 v.
I_p clamp tube	3 ma.	3 ma.

OPERATING PARAMETER	144 mc.	166 mc.
Clamp tube dissipation	.5 w.	.5 w.
Grid tuning capacitor	½ mesh	⅔ mesh
Plate tuning capacitor	⅓ mesh	⅓ mesh
Loading capacitor	⅓ mesh	⅓ mesh
Distance between plate and output coil	⅜"	⅜"
NO DRIVE CONDITION		
I_p	75 ma.	
E_p	540 v.	
Plate dissipation (tube rated at 40 w. dissipation)	37.5 w.	
I_{cg}	3 ma.	
E_{cg}	42 v.	
Screen dissipation	.12 w.	
I_p clamp tube	15 ma.	
Clamp tube dissipation	.6 w.	

acycles. Table 1 tells the complete story. The results were almost identical. After completing the test, the drive was increased to about 4 watts at 166 megacycles. Then, with careful tuning, it was possible to obtain nearly 70 watts output with efficiency on the order of 68%. With 600 plate volts available, it should be possible to obtain power output in the neighborhood of 70 watts consistently and without any difficulty.

The tuning range of the grid and plate circuits was checked cold with a grid dip meter. The grid circuit covered a tuning range of 125 to 190 megacycles. The plate circuit covered a range of 120 to 185 megacycles. With slight modification of the grid and plate circuitry, it is possible to cover a wider range of frequencies. With circuitry similar to that used in this amplifier, good results have been obtained up to 220 megacycles. With 600 plate volts available, it was possible to obtain 70 watts at even these high frequencies.

It is stressed that in building this amplifier wide copper strap be used to make all connections to the 5894 tube socket except the grids. Wire connections will not work. Also, it makes no difference in what direction the grid coils (L_3, L_5) are wound, but after mounting, the coils must continue throughout the same direction from one grid to the other.

This unit was designed for continuous commercial service. For everyday amateur use some variation can be made without affecting performance. The output control (R_2) varies power about five to seven watts, depending on load conditions. Its removal is unimportant. The filament transformer (T_1) is capable of supplying 10 amperes. It is also used to supply filament voltage to the exciter. Only 2.25 amperes is actually required for the amplifier.

An isolating filter network consisting of C_1, C_2 and RFC_1, RFC_4 and RFC_5 is employed to keep any r.f. from leaking out of the shielded chamber over the supply leads. This could cause trouble in audio and exciter units but, if omitted, would probably not be noticed in amateur work. RFC_1, incidentally, is wound from enameled wire rather than using a Z-144 choke because the Z-144 will carry only 1 ampere.

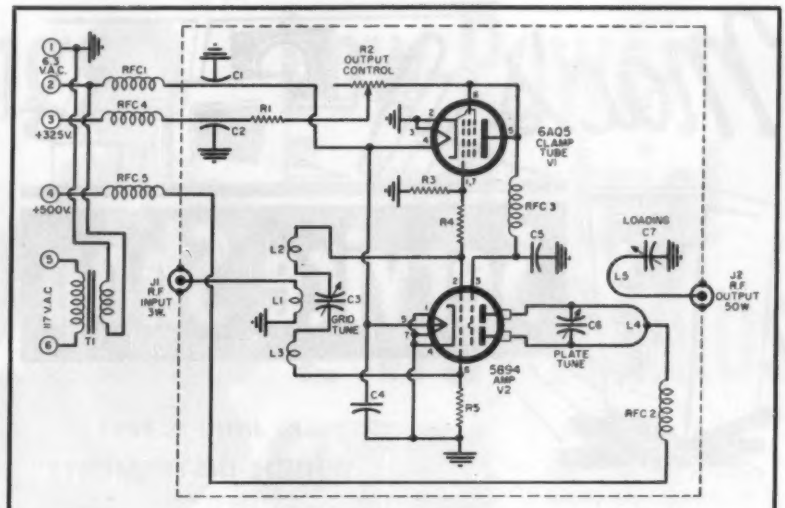
Ventilation

While the 5894 tube used does not require forced air cooling, it should not be completely shut off from free-air circulation. This can be effected by making a portion of the chassis from perforated aluminum or by drilling a few small holes. The shield cover (not shown in photographs), was constructed of perforated aluminum. As the tube heats it automatically creates an updraft and carries off most of the heat.

Tune-up

If voltages are applied to the completed amplifier without drive, or if the grid circuit is off resonance, plate current will be at a minimum. The grid circuit should then be tuned for maximum plate current. The plate circuit is next tuned for conventional dip and loading adjusted for maximum power into load or for maximum plate current. Output coupling may also be adjusted for best power output. Adjustments of the output loading capac-

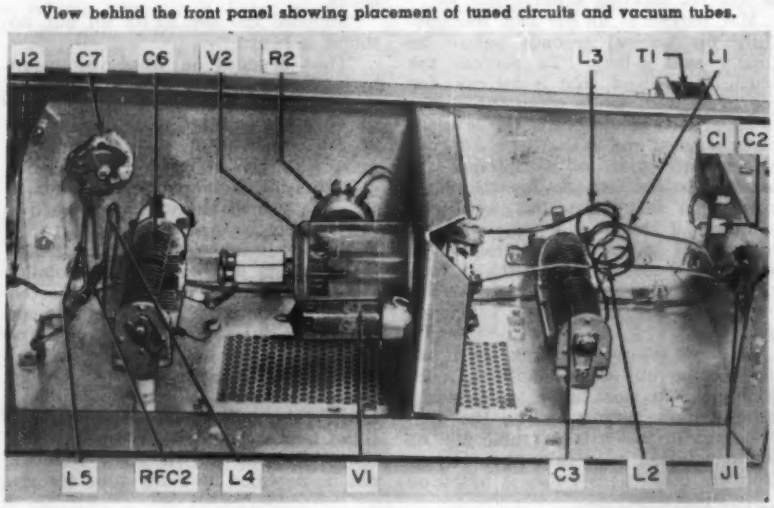
(*Continued on page* 134)



R_1—15,000 ohm, 2 w. res. ±10% (Allen-Bradley)
R_2—5000 ohm, 2 w. pot (Ohmite Type AB #CLU-5021)
R_3—10,000 ohm, 1 w. res. ±10% (Allen-Bradley)
R_4—5100 ohm, 1 w. res. ±10% (Allen-Bradley)
R_5—15,000 ohm, 1 w. res. ±10% (Allen-Bradley)
C_1, C_2—500 μμfd., 500 v. feed through capacitor (Centralab FT-500)
C_3, C_6—3-29 μμfd. var. capacitor (Hammarlund HFD-30X)
C_4, C_5—100 μμfd., 500 v. bypass capacitor (Centralab ZA-101 "Zipper")
C_7—3-28 μμfd. var. capacitor (Sarkes Tarzian O-28G)
RFC_2—R.f. choke, 14 t. #18 en., ¼" i.d. close-wound
RFC_1, RFC_3, RFC_4, RFC_5—R.f. choke (Ohmite Z-144)
J_1, J_2—U.h.f. receptacle (Amphenol #83-1R)
T_1—Fil. trans., 6.3 v. c.t. @ 10 amps. (Triad #F21-A)
L_1—Input coupling coil. 1½ t. ¾" i.d. with leads extending 2" beyond winding
L_2—Grid coil. 2 t., ¾" i.d. with one lead extending 2" beyond winding and other lead extending 1¼" beyond winding. Leads at right angles to one another
L_3—Grid coil. 1¾ t., balance same as L_2
Note: Distance between turns of L_1, L_2, and L_3 is ⅛".
L_4—Plate coil. Hairpin loop, 1⅜" between legs. 2⅛" from closed to open end. Last ⅜" of each lead has a double right-angle kink to facilitate connection to "plate tune" capacitor, C_6.
L_5—Output coupling coil. Hairpin loop, 1⅜" between legs. 1½" from closed to open end. From this point, lead to J_2 extends 1⅜" at right angles to plane of loop. Lead to C_7 extends 1½" at right angle to loop but in same plane.
Note: All coils wound with #14 bare bus wire.
1—Terminal board (Jones #6-142)
1—Shielded enclosure with partition, 14" long, 4¼" high, 6" deep, mounted on standard 19" long panel with ventilating cover.
V_2—6AQ5 tube
V_1—5894 tube (Amperex)

Complete schematic diagram and parts list of the 125-185 megacycle amplifier.

View behind the front panel showing placement of tuned circuits and vacuum tubes.



I_b clamp tube	3 ma.	3 ma.	Clamp tube dissipation	.6 w.

The amplifier was tested on two frequencies, 144 megacycles and 166 meg-

By JOHN T. FRYE

WHICH INSTRUMENT?

IT WAS a perfect October day. The temperature stood in the mid-seventies; the sun flooded the landscape with a brilliant, golden light; only a half dozen puffy little white clouds polka-dotted the deep blue canopy of the heavens. It was a perfect day to be out of doors, to roam over hill and dale; so Mac, and his helper, Barney, were toiling away at the bench of the service shop. Their customers invariably saved antenna jobs for snowy, blowy, rainy days.

"Mac," Barney said as he watched his employer removing the leads from the signal tracer and storing them away, "even after watching you all this time, I still can't figure out how you decide just which instrument to use to tackle a particular service job. I know you use the scope most of the time on TV sets; but when you are troubleshooting radios, you pick up the v.o.m. one time; next time you switch on the v.t.v.m.; again you may break out the signal tracer as you did just now; quite often I see you use signal injection with the signal generator; and many times you use the scope. How do you decide which instrument is best for tackling a particular job?"

Mac tugged at an ear lobe thoughtfully for several seconds before he finally said slowly, "To confess the truth, Flamehead, that is not easy for me to answer. Quite often the choice is apparently made below the level of consciousness and is based on sub-conscious perception of symptoms. At least I do not say to myself, 'Now since this set shows this and that symptom, I should use this particular instrument to isolate the trouble.' I just have a sort of *feeling* that a particular instrument will be best."

"That's not much help," Barney grunted.

"I know it's not; so let's see if we can't come up with something more concrete. To start with, you know I usually make a guess as to the general area in which the trouble will be found before I even take the receiver from its case. This guess is based on what the owner tells me and what I can learn by manipulating the controls and watching and listening to the set. Such guesses are by no means infallible, but in a surprising number of cases—considering how easy it is to be misled by this kind of information—the hunches turn out to be correct. Naturally certain instruments have advantages in troubleshooting different parts of the circuit; so I just use the one best suited to the area I want to examine."

"Let's have some ferinstances," Barney suggested.

"All right. Suppose we start with the a.c.-d.c. set that will not light up. Of course an open filament is most often the cause of this. If speed in locating the open filament was all that mattered, we could use the ohmmeter of the v.o.m. to check continuity of each filament until we found the open one. However, it is better to check all the tubes in a tube tester. Not only will the tube with the open filament be found in this way, but you may find some other tubes with low emission, partial shorts, and so on. This helps tube sales and guards against callbacks."

"Suppose the set lights up but no sound is heard."

"That depends on what you mean by 'no sound is heard.' If I cannot detect even the slightest hum from the speaker, I suspect an open voice coil or an open output transformer primary. In either case, I'd probably check with the ohmmeter of the v.o.m. I prefer it over the v.t.v.m. in such a case simply because it is ready to go and requires no warm-up. If I heard a faint hum but no program coming from the speaker, I'd suspect a shorted bypass capacitor, an open resistor, or a shorted tube. Quite likely I'd try substituting tubes first because I could do this without removing the set from the cabinet. I'd be sure to try new mixer tubes and new second detector tubes because I know from experience that these can fail in ways that will not be revealed by many tube testers. After I had the set playing, then I'd run all the tubes through the checker.

"If new tubes did not clear the trouble, I'd switch on the v.t.v.m. before starting to take out the chassis screws and let it be warming up as I got the set out on the bench and secured the diagram and voltage data from the service files. I know that a methodical voltage check is the best way to locate the trouble and I like to use the v.t.v.m. for an extensive voltage check for several reasons: (1) It is less likely to be damaged by an unexpected high voltage you often encounter when you make a mistake on a pin number—which is very easy to do in a crowded chassis. (2) The v.t.v.m. loads a.v.c. circuits, an oscillator grid, and other similar points much less heavily than does the ordinary v.o.m. (3) One lead from the v.t.v.m. can be left clipped to the circuit ground and the meter switched to read positive or negative voltages as required."

"When you find an incorrect voltage what do you do?"

"Usually I switch off the set and fall back on the ohmmeter portion of the meter I'm using to try and run down a leaky capacitor, defective resistor, or what have you."

"Why did you use the signal tracer just now?"

"Because the complaint was distorted sound. I wanted to locate the exact part of the circuit where the distortion began and I quickly found it started at the grid of the first audio stage. The bias cells supposed to keep a negative potential on this grid had gone sour and left it at ground potential. As soon as I found the distortion started there, the cells were checked with the v.t.v.m. and found to be dead. I particularly like to use the signal tracer in working with noise or distortion that arises in the audio portion of a receiver."

"Why not in the r.f. and i.f. portions?"

"Because it tends to detune the circuits there and produce misleading results. I much prefer to inject a signal of the proper frequency from the signal generator and see how it feeds through these circuits. I know just about how much input signal is required at a mixer grid or plate or an i.f. grid or plate to produce a comfortable volume from the speaker of a set that is working normally. Bad i.f. transformers or stages that are not putting out what they should are easily spotted with this signal-injection technique."

"How about the noisy sets? What do you use on them?"

"Depends on what kind of a noise it is. The scope is mighty hard to beat for running down hum. You can tell at a glance if the hum is 60- or 120-cycle, if a filter capacitor is doing the job it should, or if a filament-to-cathode short is putting an a.c. voltage on the cathode. With enough experience, you can almost tell from a look

(*Continued on page* 158)

If voltages are applied to the com-

Servicing Low-Power Industrial 2-Way Radios

Fig. 1. Two-way units on fork-lift trucks coordinate supervisor with drivers.

A fast-growing field holds promise for technicians seeking growth through diversification of service.

By **PHILIP J. D'ELIA**
Test Department Manager
Kaar Engineering Corp.

THE RAPID adoption of two-way radio by industry presents new opportunities to the electronic service technician. Most of the licensees owning equipment in this category will not employ full-time technicians to service their radio equipment, but will instead farm out the work to qualified service contractors.

Any commercial enterprise meeting citizenship requirements is eligible for licensing in the low-power industrial radio service. In this service, power input to the final r.f. stage of the transmitter is limited to 3 watts, remote control of base stations is prohibited, and the assigned frequencies are shared with other licensees in the same category. It is intended that communication be confined, for example, to a single general plant area. The specific frequencies currently available to this service are 27.51, 33.14, 35.02, 42.98, and 154.57 mc. Thus any company or individual engaged in a commercial enterprise may use two-way radio of this type for short-range communication. Licensing in other categories where higher power, longer range equipment may be used is restricted exclusively to certain types of industrial operations.

The rush to make use of low-power industrial radio has been impressive. A large suburban shopping center in Seattle has equipped its security patrol cars with low-power two-way radio. At the Reno airport, service vehicles are dispatched by radio. The materials-handling trucks in a large grocery warehouse in Palo Alto are radio-equipped, as are the fork-lift trucks, cranes, and a locomotive in a huge electric motor plant in Sunnyvale. Golf courses, schools, open-pit mines, and lumber yards are among the growing list of users of low-power facilities.

In the field, maintenance is generally confined to checking of the wiring on vehicles. The most common trouble is that of inadequate power reaching the mobile unit. The battery voltage, plugs, fuses, and cables should be checked. It is worth noting that low battery voltage can prevent transmitter operation even when the receiver portion seems to operate normally. Remembering this may prevent a wild-goose chase when such a symptom occurs.

Since interruption of communications can cost money, the mobile unit is nearly always removed from the vehicle when it is being given preventive or emergency maintenance. A spare unit is installed in its place so that the vehicle need not be taken out of service or handicapped by the absence of radio.

A typical mobile radio installation on a fork-lift truck, as shown in Fig. 1, consists of the communications unit, antenna, palm microphone or handset, shockmount, and power wiring. In some instances an auxiliary loudspeaker is included to permit use of the radio equipment as a mobile paging system. In the case of gasoline-powered vehicles, electric power is derived from the 6- or 12-volt vehicle battery. On electrically propelled vehicles which use batteries of various higher voltage ratings, a separate battery may be provided for furnishing either 6 or 12 volts to the mobile radio unit. A d.c.-to-a.c. inverter may be used for delivering 117 volts a.c. to the mobile unit.

Direct operation from the vehicle battery bank is possible by installing radio equipment designed to operate with that particular input voltage or by using a voltage-dropping arrangement to reduce the available battery voltage to 12 volts. A series-ballast arrangement of the kind shown in Fig. 2 may be made up for ready adaptation of a mobile unit to several different battery voltages. In the case shown, a 12-volt unit may be operated from batteries ranging in output voltage from 24 to 48 by choosing the correct connection for a jumper wire.

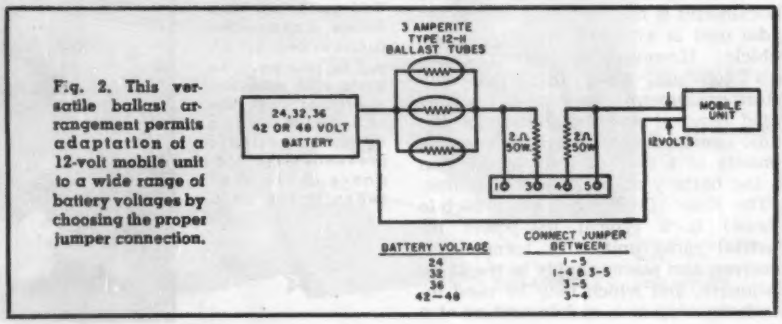
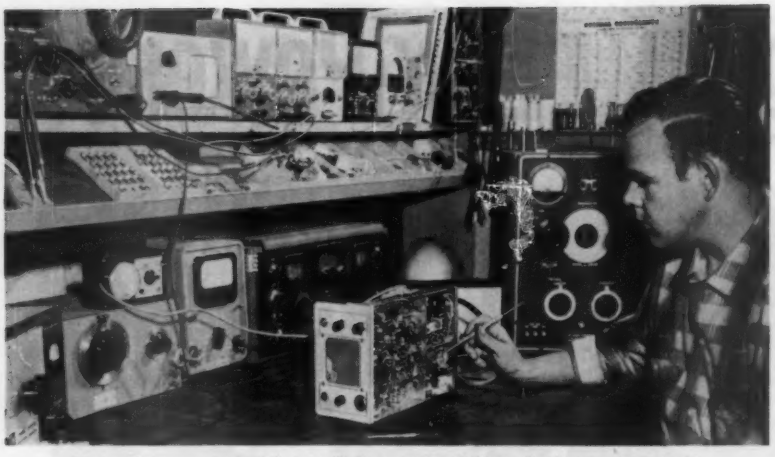


Fig. 2. This versatile ballast arrangement permits adaptation of a 12-volt mobile unit to a wide range of battery voltages by choosing the proper jumper connection.



The author uses a crystal-controlled generator (left) to check a two-way unit.

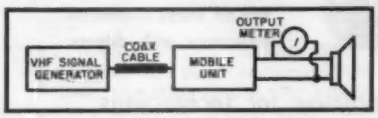


Fig. 3. Receiver section is checked with signal generator and output meter.

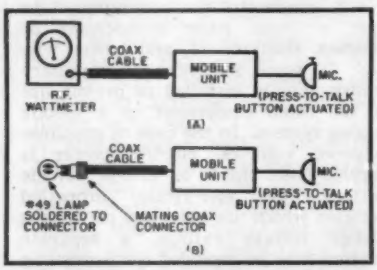


Fig. 4. Transmitter performance may be checked by measuring power output (A) accurately with an r.f. wattmeter or (B) approximately with a #49 pilot lamp.

To permit the use of one universal radio unit, many systems use mobile units which are operable from either an a.c. source or a 6- or 12-volt battery without modification.

The antenna is a plug-in whip. When operating on 154.57 mc., the antenna is about 18 inches long. A new type of antenna for use on low-power industrial frequencies in the 30-50 mc. band is kept short by the use of a loading coil near the base. The palm- or hand-held microphone plugs into the front panel or control box, when one is used. In some cases a shockmount is not used and the mobile radio unit is attached directly to the vehicle. However, shockmounts are now common, since they not only afford equipment protection but permit rapid removal and installation of the radio unit. Power wiring generally consists of a pair of leads which run to the battery or other power source.

The *Kaar* "IMP" (Industrial Mobile Phone) is a typical low-power industrial radio unit with transmitter, receiver, and power supply in the same enclosure, and which may be used interchangeably as a mobile unit or at a fixed point, as a base station. It will operate from a 117-volt a.c. source without a converter, from a 6- or 12-volt battery, or with a dropping resistor. Although designed especially for operation on the low-power industrial channel at 154.57 mc., the "IMP" may be operated on any single frequency in the 152 to 174 mc. band and other models are available at other frequencies. Power input to the final r.f. stage is less than 3 watts, as specified by FCC regulations for low-power industrial service.

No adjustments except the setting of volume level, squelch, and function selection controls on the front panel need be made by the user after the mobile unit has been installed. The installation may be made by non-technical personnel provided the transmitter adjustments are not touched. Access to the chassis is obtained by unlocking the cover with the key provided with the unit.

When operating as a base station, a plug-in whip antenna may be used or an external antenna may be connected through no more than 25 feet of coaxial cable. The limitation on coaxial cable length is prescribed by FCC regulations and applies only to the low-power industrial radio service.

With electronic equipment used in the home, it is customary to wait for a breakdown to occur before any repair work is done. With systems of the type described here, it is generally not considered wise to run unnecessary risk of having the equipment fail when it is needed most. Most operators prefer to have their systems checked at regular intervals to insure continuing optimum performance and maximum reliability. For this type of check, as well as for emergency repair, the units are brought into the properly equipped shop.

Cleaning is an important part of preventive maintenance. Foreign matter should be kept away from the chassis and all contacts, especially those on relays, should be kept clean. A rigorous visual inspection should be made of all components to detect incipient signs of wear or potential defects. Again, relays should especially be scrutinized. All tubes should be tested, transmitter frequency should be measured, and both receiver and transmitter sections should be re-aligned, if necessary.

Receiver performance is checked by feeding a signal to the receiver antenna input jack and measuring the audio output, as shown in Fig. 3. The manufacturer's recommendations should be followed on how much signal should be fed to the unit and how much output should be expected. In the case of the *Kaar* "IMP" for example, one watt of audio should be measured at the speaker terminals when a signal of 1 to 1.5 microvolts, modulated at 30 per-cent, is fed to the receiver input.

If the receiver fails to pass this test, the alignment trimmers should be touched up and tubes should be inspected. The tubes may be checked in a general-purpose tester for transconductance, mutual conductance, plate conductance or emission, depending upon the type of tester used, and bad tubes should be replaced. The tubes may also be checked in a grid-circuit tester so that tubes with grid emission or excessive interelectrode leakage may be identified and replaced. Grid emission is an elusive trouble in new as well as used tubes which is not detected by conventional general-purpose tube testers and which can cause erratic operation.

☆

Grid emission often causes hard-to-find difficulties in the v.h.f. range. To avoid such problems, a grid-circuit tube checker is being used in a periodic preventive-maintenance check of all tubes in the unit.

☆

After obviously defective tubes have been replaced, sensitivity should be measured and trimmers should be readjusted, as prescribed in the manufacturer's instruction manual, for optimum performance. Sometimes it may be necessary to substitute new tubes, one-at-a-time, observing receiver gain after each substitution, since some tubes which check OK on tube testers may fail to function properly in some applications.

Transmitter tubes can also be tested on a general-purpose tester to detect obvious faults. Then they can be tested in the set by monitoring the various transmitter stages with a suitable test meter, according to the particular manufacturer's instruction book. Power output may be measured with an r.f. wattmeter, or approximated by observing the glow of a type #49 pilot lamp used as a dummy load. These techniques are shown in Fig. 4.

If power output is below normal or drops rapidly, new tubes may be tried one-at-a-time in the quest for improvement. Caution should be exercised to avoid shock when the transmitter is turned on. Prolonged operation of the transmitter, especially when it is not correctly tuned, is to be avoided to prevent damage to the tubes or components. A dummy antenna load (#49 lamp is usually suitable) must be used when the transmitter is turned on to provide a proper load and to minimize radiation which could cause harmful radio interference.

For alignment of v.h.f. communications equipment, an instrument of the type ordinarily used for servicing home radio and television receivers is not always satisfactory. The problem is not merely that of accuracy; at certain times it will be desirable or necessary to use a greatly attenuated output from the generator. On ordinary instruments, even with the attenuation control set to minimum, signal leakage will be so high as to prevent sufficient reduction. There are a number of suitable instruments on the market and they are expensive.

The best alignment procedure to follow is the one specified by the manufacturer of the equipment. His recommendation as to the type of meter or other indicating device to be used should also be followed. Sometimes a crystal-controlled reference oscillator is used to make sure that the signal generator is tuned to the correct frequency. The signal generator is adjusted for zero beat with this reference signal.

Transmitter frequency should be measured only with a frequency meter approved by the FCC, and the result of this test should be recorded. The exact frequency should be written down, rather than just an "OK" notation. Where the system works on FM, frequency deviation should also be measured. In some sets, the transmitter can be adjusted to exact frequency by manipulation of a trimmer capacitor across the crystal.

(*Continued on page* 178)

COVER STORY

The steady character of repair and maintenance work in an electronic specialty, low-power two-way mobile radio, attracts many service professionals who seek new income sources free of unpredictable fluctuation.

THERE WILL always be a certain percentage of failures among electronic service shops. Of those that fail to make a go of it, it would be interesting to know how many were hovering on the edge of solvency until an unexpected downtrend in business, that would not ordinarily be of great duration, closed the doors for good.

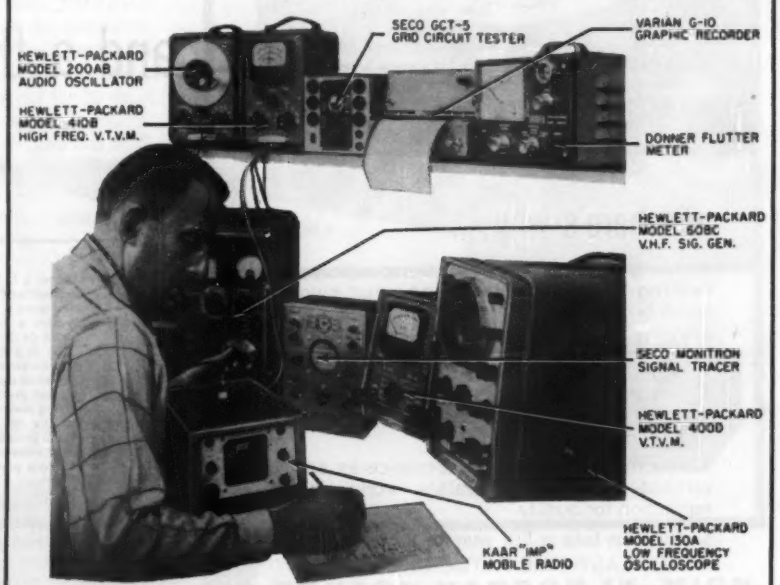
The search for steadier work that can fill in such dangerous gaps has been going on for many years. Nowadays, service also seeks relief from another pressure: in some areas, even where the full potential in repair of home radio and TV sets is realized, income is still not sufficient to ward off the curse of marginal operation. To this latter problem, the magic word, diversification, has been offered as an answer. In other words, just find something additional to work on.

While this is more easily said than done, many establishments have found answers to both problems in the steady growth of two-way mobile radio. The manufacturers of these systems have not, in general, found it wise for them to undertake service and maintenance on their own, doing so only under the necessity of providing such support in order to get the product sold. They have preferred to turn over the actual work to established service organizations.

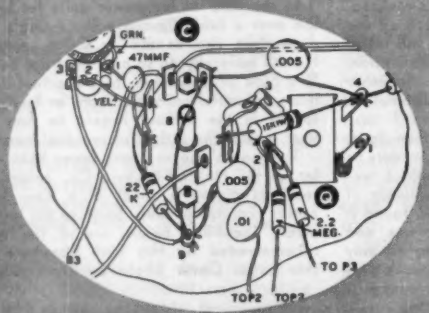
In the case of larger systems, which may involve vehicles ranging over a broad area away from the base station, it is not feasible for a single facility to provide all of the service. The manufacturer, then, is the holder of the fixed-fee service contract, but local authorized independents, billing back to the manufacturers, handle whatever work is required wherever the mobile unit happens to be at the time it needs attention.

In the case of low-power units for local use over a fairly limited area, a single independent can handle an entire system. He will generally do so on a contract basis. This type of operation, plus the fact that these industrial units are more or less uniformly in use without regard to time of year, avoids the pitfalls of seasonal income.

This month's cover photo shows Milo Adler, of the Hewlett-Packard Co., recording readings during a check of a Kaar low-power radiotelephone. Some of his instruments, identified below, are of the type recommended for this work elsewhere on this page. Cover photo by Cyril Glunk.


HEWLETT-PACKARD MODEL 200AB AUDIO OSCILLATOR
HEWLETT-PACKARD MODEL 410B HIGH FREQ. V.T.V.M.
SECO GCT-5 GRID CIRCUIT TESTER
VARIAN G-10 GRAPHIC RECORDER
DONNER FLUTTER METER
HEWLETT-PACKARD MODEL 608C V.H.F. SIG. GEN.
SECO MONITRON SIGNAL TRACER
HEWLETT-PACKARD MODEL 400D V.T.V.M.
HEWLETT-PACKARD MODEL 130A LOW FREQUENCY OSCILLOSCOPE
KAAR "IMP" MOBILE RADIO

Motion picture and TV personality, Jackie Coogan, looks on with unbelieving interest as his 14-year-old son, Anthony, prepares to assemble his latest Heathkit, a hi-fi FM tuner. The Coogans have found out about the fun and savings of building their own electronic equipment the Heathkit way . . . so why don't you?



You'll get plenty of these detailed pictorial diagrams in your Heathkit construction manual to show where each and every wire and part is to be placed. Everything you do is spelled out in pictures so you can't go wrong. That's what makes it such fun!

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By DAYSTROM

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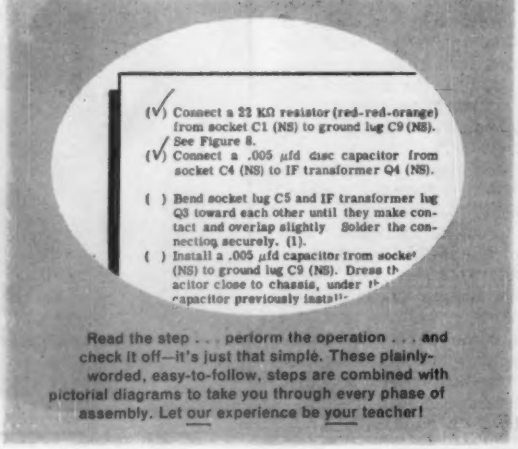
4. You may depend on performance as advertised—backed by Heath's world-wide reputation for quality.
5. You can take a full year to pay with the HEATH EASY TIME PAYMENT PLAN.


(√) Connect a 22 KΩ resistor (red-red-orange) from socket C1 (NS) to ground lug C9 (NS). See Figure 8.
(√) Connect a .005 μfd disc capacitor from socket C4 (NS) to IF transformer Q4 (NS).
( ) Bend socket lug C5 and IF transformer lug Q3 toward each other until they make contact and overlap slightly. Solder the connection securely. (1).
( ) Install a .005 μfd capacitor from socket (NS) to ground lug C9 (NS). Dress the capacitor close to chassis, under the capacitor previously install

Read the step . . . perform the operation . . . and check it off—it's just that simple. These plainly-worded, easy-to-follow, steps are combined with pictorial diagrams to take you through every phase of assembly. Let our experience be your teacher!

TIME PAYMENTS . . .

The Heath Time Payment Plan was designed for your convenience. Now, you can order the kits of your choice, and pay for them in small monthly installments. Write for full details.

HEATHKIT EXTRA PERFORMANCE 70-WATT AMPLIFIER KIT

For really high performance, with plenty of reserve power, the W-6M is a natural. The full 70-watts output will seldom, if ever, be required. However, this reserve insures distortion-less sound on power peaks. The W-6M will loaf along at normal listening levels and yet is always ready to extend itself when program material demands it, without the least amount of strain. The output circuit employs 6550 tubes with a special-design Peerless output transformer for maximum stability at all power levels. A quick-change plug selects 4, 8 and 16 ohms or 70-volt output and the correct feedback resistance. A variable damping control is also provided for optimum performance with any speaker system. Extremely good power supply regulation is possible through the use of a heavy-duty transformer along with silicon-diode rectifiers, which are noted for their very long life, and yet are smaller than a house fuse. Frequency response at 1 watt is ±1 db from 5 cps to 80 kc with controlled hf rolloff above 100 kc. At 70 watts output harmonic distortion is below 2%, 20 to 20,000 cps and IM distortion below 1%, 60 and 6,000 cps. Hum and noise 88 db below full output. In addition to high performance, its fine appearance makes it a pleasure to display in your living room. Proper layout of chassis insures ease of assembly by eliminating those cramped and difficult places to get at. Clear instructions—and top-quality components. Get started now and make this amplifier the heart of your hi-fi system. Shipped express only. Shpg. Wt. 50 lbs.

MODEL W-6M
$109.95

MODEL W-6: Consists of W-6M kit, plus WA-P2 preamplifier. Express only. Shpg. Wt. 59 lbs. $129.70

HEATHKIT HIGH FIDELITY FM TUNER KIT

This tuner can bring you a rich store of FM programming, your least expensive source of high fidelity material. It covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. Features broadbanded circuits for full fidelity, and better than 10 uv sensitivity for 20 db of quieting, to pull in stations with clarity and full volume. Employs a high gain, cascode RF amplifier, and has AGC. A ratio detector provides high-efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit. Special alignment equipment is not necessary. Edge-lighted glass dial for easy tuning. Here is FM for your home at a price you can afford. Shpg. Wt. 8 lbs.

MODEL FM-3A
$25.95
(with cabinet)

HEATHKIT BROADBAND AM TUNER KIT

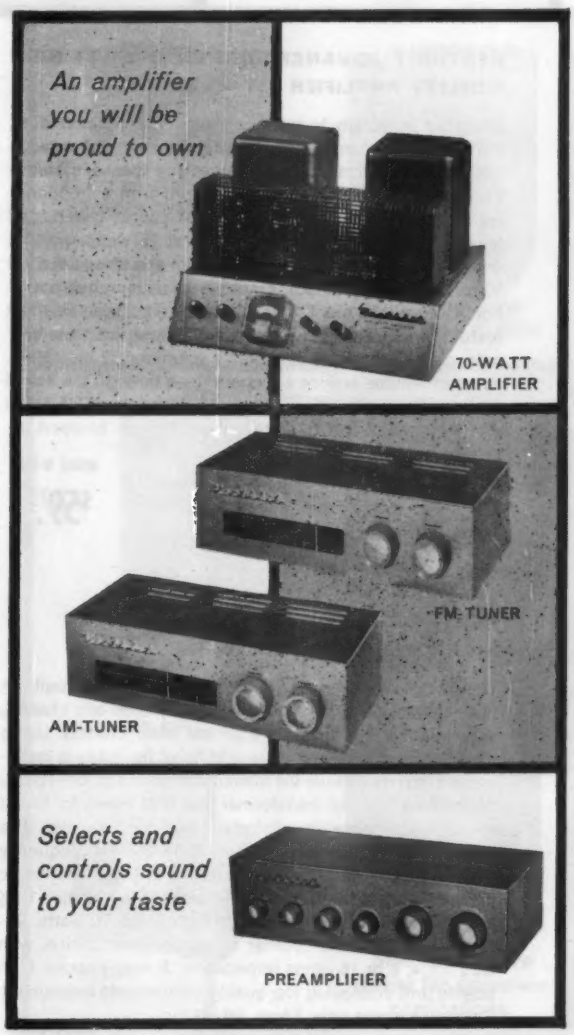
This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuits feature broad band-width, to insure low signal distortion. Audio response is ±1 db from 20 cps to 9 kc, with 5 db of preemphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent, and tuner covers complete broadcast band from 550 to 1600 kc. Quiet performance is assured by 6 db signal-to-noise ratio at 2.5 UV. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide-rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 8 lbs.

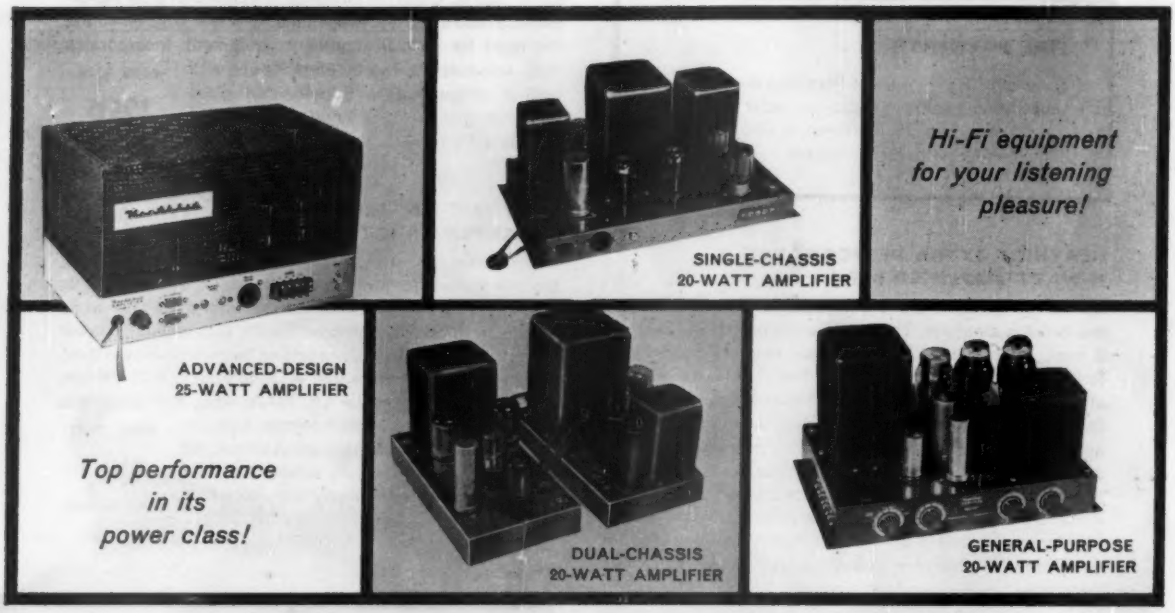
MODEL BC-1A
$25.95
(with cabinet)

HEATHKIT MASTER CONTROL PREAMPLIFIER KIT

Designed for use with any of the Williamson-type amplifiers, the WA-P2 has five switch-selected inputs, each having its own level control to eliminate blasting or fading while switching through the various inputs, plus a tape recorder output. A hum control allows setting for minimum hum level. Frequency response is within ±1½ db from 15 to 35,000 cps. Equalization provided for LP, RIAA, AES, and early 78's. Separate bass and treble controls. Low impedance cathode follower output circuit. All components were specially selected for their high quality. Includes many features which will eventually be desired. Shpg. Wt. 7 lbs.

MODEL WA-P2
$19.75
(with cabinet)





HEATHKIT ADVANCED-DESIGN 25-WATT HIGH FIDELITY AMPLIFIER KIT

Designed especially to satisfy critical audio requirements, the W-5M incorporates the extra features needed to compliment the finest in program sources and speaker systems. Faithful sound reproduction is assured with a frequency response of ±1 db from 5 to 160,000 cps at 1 watt, and harmonic distortion is less than 1% at 25 watts, with IM distortion less than 1% at 20 watts. Hum and noise are a full 99 db below rated output, assuring quiet, hum-free operation. Output taps are 4, 8 and 16 ohms. Exclusive Heathkit features include the "tweeter saver", and the "bas-bal" balancing circuit, requiring only a voltmeter for indication. Years of reliable service are guaranteed through the use of conservatively rated, high quality components. KT66 tubes and Peerless output transformer are typical. Shipped express only. Shpg. Wt. 31 lbs.

MODEL W-5M

MODEL W-5: Consists of W-5M kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 38 lbs. $79.50

$59.75

HEATHKIT DUAL-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W3-AM is a Williamson-type amplifier built on two separate chassis. The power supply is on one chassis, and the amplifier stages are on the other chassis. Using two separate chassis provides additional flexibility in installation. Features include the famous acrosound model TO-300 "ultralinear" output transformer and 5881 tubes for broad frequency response, low distortion, and low hum level. The result is exceptionally fine overall tone quality. Frequency response is ±1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion is less than 1% and IM distortion is less than 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Designed to match the speaker system of your choice, with taps for 4, 8 or 16 ohms impedance. A very popular high fidelity unit employing top quality components throughout. Shipped express only. Shpg. Wt. 29 lbs.

MODEL W-3AM

MODEL W-3A: Consists of W-3AM kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 37 lbs. $69.50

$49.75

HEATHKIT SINGLE-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W4-AM Williamson-type amplifier will amaze you with its outstanding performance. A true Williamson circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can provide you with many hours of listening enjoyment with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extending from 10 cps to 100 kc within ±1 db at 1 watt assures you of full coverage of the audio range, and clean clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms. Shipped express only. Shpg. Wt. 28 lbs.

MODEL W4-AM

MODEL W-4A: Consists of W-4AM kit above, plus model WA-P2 preamplifier. Express only. Shpg. Wt. 35 lbs. $59.50.

$39.75

Heathkits...

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bring you the lasting satisfaction of personal accomplishment

HEATHKIT GENERAL-PURPOSE 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model A-9C will provide you with high quality sound at low cost. Features a built-in preamplifier with four separate inputs, and individual volume, bass and treble controls. Frequency response covers 20 to 20,000 cps within ±1 db. Total harmonic distortion is less than 1% at 3 db below rated output. Push-pull 6L6 tubes are used, with output transformer tapped at 4, 8, 16 and 500 ohms. A true hi-fi unit using high-quality components throughout, including heavy-duty "potted" transformers. Shpg. Wt. 23 lbs.

MODEL A-9C

$35.50

HEATHKIT "BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

The extremely popular Heathkit model SS-1 Speaker System provides amazing high fidelity performance for its size. Features two high-quality Jensen speakers, an 8" mid-range woofer and compression-type tweeter with flared horn. Covers from 50 to 12,000 CPS within ±5 db, in a special-design ducted-port, bass reflex enclosure. Impedance is 16 ohms. Cabinet measures 11½" H x 23" W x 11¾" D. Constructed of veneer-surfaced plywood, ½" thick, suitable for light or dark finish. All wood parts are precut and predrilled for easy, quick assembly. Shpg. Wt. 30 lbs.

MODEL SS-1

$39.95

HEATHKIT "RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

Extends the range of the SS-1 to ±5 db from 35 to 16,000 CPS. Uses 15" woofer and super-tweeter both by Jensen. Kit includes crossover circuit. Impedance is 16 ohms and power rating is 35 watts. Measures 29" H x 23" W x 17½" D. Constructed of veneer-surfaced plywood ¾" thick. Easy to build! Shpg. Wt. 80 lbs.

MODEL SS-1B

$99.95

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let you save up to ½ or more on all types of electronic equipment.

HEATHKIT SINE-SQUARE GENERATOR

The new AG-10 provides high quality, sine and square waves over a wide range, for countless applications. Some of these are; radio and TV repair work, checking scope performance, as a variable trigger source for telemetering and pulse work, and checking audio, video and hi-fi amplifier response. Frequency response is ±1.5 db from 20 CPS to 1 MC on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Sine wave output impedance 600 ohms, square wave output impedance 50 ohms, (except on 10v ranges). Square wave rise time less than .15 usec. Five-position band switch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1, and .1 volts for both sine and square wave, with extra range of .01 volt on sine wave. Both sine and square wave can be used at the same time without affecting either wave form. Power supply uses silicon-diode rectifiers. Shpg. Wt. 12 lbs.

MODEL AG-10

$49.95

HEATHKIT AUDIO ANALYZER KIT

The AA-1 is actually three instruments in one compact package. It combines the functions of an AC VTVM, an audio wattmeter, and an intermodulation analyzer. Input and output terminals are combined, and high and low frequency oscillators are built in. VTVM ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts (RMS). Wattmeter ranges are .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w and 150 w. IM scales are 1%, 3%, 10%, 30% and 100%. Provides internal load resistors of 4, 8, 16 or 600 ohms. A tremendous dollar value. Shpg. Wt. 13 lbs.

MODEL AA-1

$49.95

HEATHKIT "LEGATO" HIGH FIDELITY SPEAKER SYSTEM KIT

The quality of the Legato, in terms of the engineering that went into the initial design, and in terms of the materials used in its construction, is matched in only the most expensive speaker systems available today. The listening experience it provides approaches the ultimate in esthetic satisfaction. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high-frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high frequency channel into phase with the low frequency channel to eliminate peaks or valleys at the crossover point, by equalizing the acoustical centers of the speakers. The enclosure is a modified infinite baffle type, especially designed for these speakers. Cabinet is constructed of veneer-surfaced plywood, ¾" thick, precut and predrilled for easy assembly. Frequency response 25 to 20,000 CPS. Power rating, 50 watts program material. Impedance is 16 ohms. Cabinet dimensions 41" L x 22¼" D x 34" H.

Choice of two beautiful cabinets. Model HH-1-C in imported white birch for light finishes, and HH-1-CM in African mahogany for dark finishes. Shpg. Wt. 195 lbs.

MODEL HH-1-C
MODEL HH-1-CM

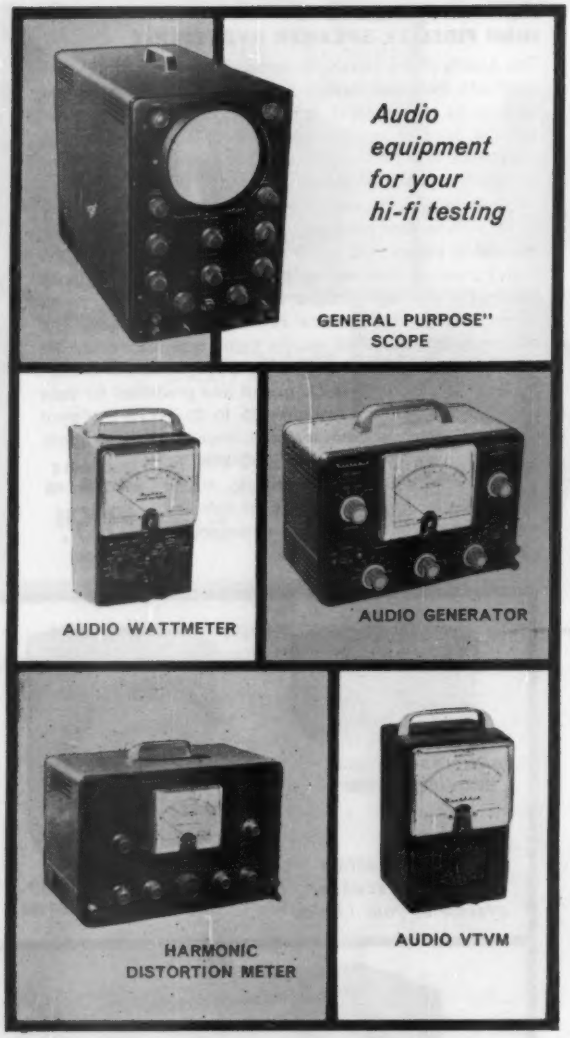
$325.00 EACH

"BASIC RANGE" HI-FI SPEAKER SYSTEM
Superlative sound reproduction through the speaker system of your choice
"RANGE EXTENDING" HI-FI SPEAKER SYSTEM
"LEGATO" HI-FI SPEAKER SYSTEM
SINE-SQUARE GENERATOR
AUDIO ANALYZER
Sine and square waves for countless applications.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT COLOR BAR AND DOT GENERATOR

HEATHKIT "EXTRA DUTY" 5"



HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

The model OM-2 Oscilloscope is especially popular with part-time service technicians, students, and high fidelity enthusiasts. It features good vertical frequency response ±3 db from 4 cps to over 1.2 mc. A full five-inch crt, and sweep generator operation from 20 cps to over 150 kc. Stability is excellent and calibrated grid screen allows precise signal observation. Extra features include external or internal sweep and sync, 1-volt peak-to-peak calibrating reference, 3-position step-attenuated input, adjustable spot shape control, push-pull horizontal and vertical amplifiers, and modern etched-metal circuits. Easy to build and a pleasure to use. Ideal for use with other audio equipment for checking amplifiers. Shpg. Wt. 21 lbs.

MODEL OM-2

$42.50

HEATHKIT AUDIO WATTMETER KIT

The AW-1 Audio Wattmeter can be used in any application where audio power output is to be measured. Non-inductive LOAD resistors are built in for 4, 8, 16 or 600 ohms impedance. Five power ranges cover 0-5 mw, 50 mw, 500 mw, 5 w, and 50 w full scale. Five switch-selected db ranges cover −10 db to +30 db. All indications are read directly on a large 4½" 200 microampere meter. Frequency response is ±1 db from 10 cps to 250 kc. Precision type multiplier resistors used for high accuracy, and crystal diode bridge for wide-range frequency response. This meter is used in many recording studios and broadcast stations as a monitor as well as servicing. A fine meter to help supply the answers to your audio operating or power output problems. Shpg. Wt. 6 lbs.

MODEL AW-1

$29.50

HEATHKIT AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1,3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than .1 of 1% between 20 and 20,000 cps. Total range is 10 cps to 100 kc. Shpg. Wt. 8 lbs.

MODEL AG-9A

$34.50

HEATHKIT HARMONIC DISTORTION METER KIT

All sounds consist of dominant tones plus harmonics (overtones). These harmonics enrich the quality and brightness of the music. However, additional harmonics which originate in the audio equipment, represent distortion. Used with an audio signal generator, the HD-1 will accurately measure this harmonic distortion at any or all frequencies between 20 and 20,000 cps. Distortion is read directly on the panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio measurements are also permitted through the use of a separate meter scale calibrated in db. High quality components insure years of outstanding performance. Full instructions are provided. Shpg. Wt. 13 lbs.

MODEL HD-1

$49.50

Heathkits...

By DAYSTROM

are well known for their high quality and reliability.

HEATHKIT AUDIO VTVM KIT

This new and improved AC Vacuum Tube Voltmeter is designed especially for audio measurements and low-level AC measurements in power supply filters, etc. Employs an entirely new circuit featuring a cascode amplifier with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding stages. It emphasizes stability, broad frequency response, and sensitivity. Frequency response is essentially flat from 10 cps to 200 kc. Input impedance is 1 megohm at 1000 cps. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover −52 db to +52 db. Features large 4½" 200 microampere meter, with increased damping in meter circuit for stability in low frequency tests. 1% precision resistors employed for maximum accuracy. Stable, reliable performance in all applications. Shpg. Wt. 5 lbs.

MODEL AV-3

$29.95

HEATHKIT COLOR BAR AND DOT GENERATOR

The CD-1 combines the two basic color service instruments, a Color Bar Generator and White Dot Generator in one versatile portable unit, which has crystal-controlled accuracy and stability (no external sync lead required). Produces white-dots, cross hatch, horizontal and vertical bars, 10 vertical color bars, and a new shading bar pattern for screen and background adjustments. Variable RF output on any channel from 2 to 6. Positive or negative video output, variable from 0 to 10 volts peak-to-peak. Crystal controlled sound carrier with off-on switch. Voltage regulated power supply using long-life silicon rectifiers. Gain knowledge of a new and profitable field by constructing this kit. Shpg. Wt. 12 lbs.

MODEL CD-1

$59.95

Heathkits...

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are guaranteed to meet or exceed advertised specifications

HEATHKIT TV ALIGNMENT GENERATOR KIT

This fine TV alignment generator offers stability and flexibility difficult to obtain even in instruments costing several times this low Heathkit price. It covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. The all-electronic sweep circuit insures stability. Crystal marker and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking to eliminate return trace. Phasing control. Kit is complete, including three output cables. Shpg. Wt. 16 lbs.

MODEL TS-4A

$49.50

HEATHKIT "EXTRA DUTY" 5" OSCILLOSCOPE KIT

This fine oscilloscope compares favorably to other scopes costing twice its price. It contains the extra performance so necessary for monochrome and color-TV servicing. Features push-pull horizontal and vertical output amplifiers, a 5UP1 CRT, built in peak-to-peak calibration source, a fully compensated 3-position step-type input attenuator, retrace blanking, phasing control, and provision for Z-axis modulation. Vertical amplifier frequency response is within +1.5 and −5 db from 3 CPS to 5 MC. Response at 3.58 MC down only 2.2 db. Sensitivity is 0.025 volts RMS/inch at 1 kc. Sweep generator covers 20 CPS to 500 kc in five steps, five times the usual sweep obtained in other scopes through the use of the patented Heath sweep circuit. Etched-metal circuit boards reduce assembly time and minimize errors in assembly, and more importantly, permit a level of circuit stability never before achieved in an oscilloscope of this type. Shpg. Wt. 21 lbs.

MODEL O-11

$69.50

HEATHKIT ELECTRONIC SWITCH KIT

A valuable accessory for any oscilloscope owner. It allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. Four switching rates. Provides gain for input signals. Frequency response ±1 db, 0 to 100 kc. A sync output is provided to control and stabilize scope sweep. Ideal for observing input and output of amplifiers simultaneously. Shpg. Wt. 8 lbs.

MODEL S-3

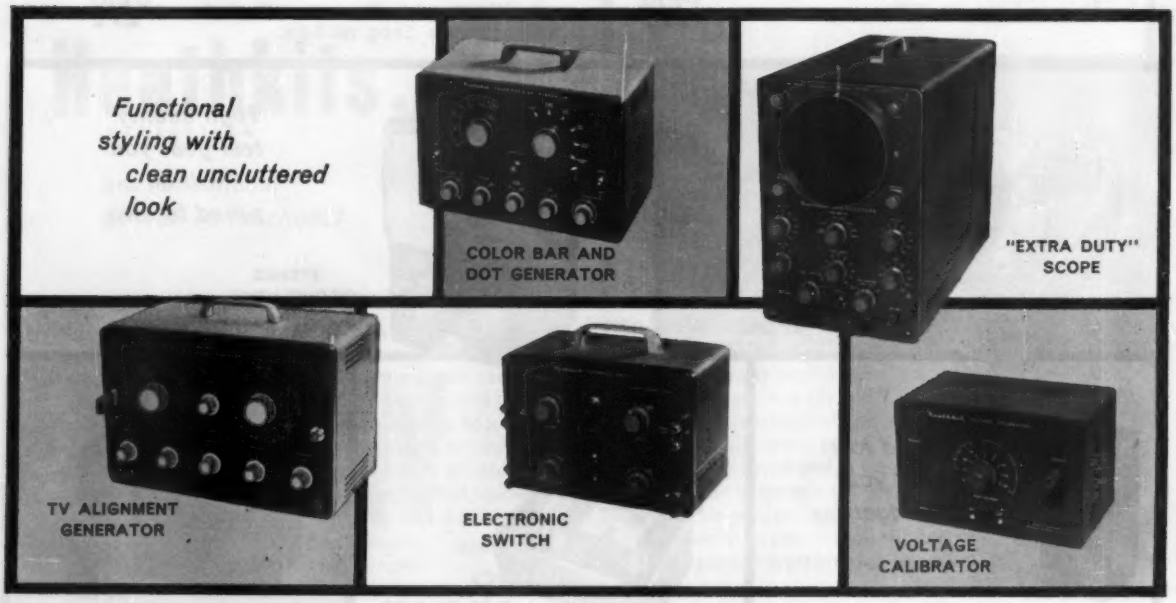
$21.95

HEATHKIT VOLTAGE CALIBRATOR KIT

This unit is an excellent companion for your oscilloscope. Used as a source of calibrating voltage, it produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors insure accurate output amplitude, and multivibrator circuit guarantees good sharp square waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switches are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30 and 100 volts peak-to-peak. Allows measurment of unknown signal amplitude by comparing it to the known output of the VC-3 on oscilloscope. Shpg. Wt. 4 lbs.

MODEL VC-3

$12.50



HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT RF SIGNAL GENERATOR KIT

HEATHKIT TUBE CHECKER KIT

Eliminate guesswork, and save time in servicing or experimenting. The TC-2 tests tubes for shorted elements, open elements, filament continuity, and operating quality on the basis of total emission. It tests all tube types encountered in radio and TV service work. Sockets are provided for 4, 5, 6 and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, 5 pin hytron miniatures, and pilot lamps. Tube condition indicated on 4½" meter with multicolor "good-bad" scale. Illuminated roll chart with all test data built in. Switch selection of 14 different filament voltages from .75 to 117 volts. Color-coded cable harness allows neat professional wiring and simplifies construction. Very easy to build, even for a beginner. Shpg. Wt. 12 lbs.

MODEL TC-2

$29.50

HEATHKIT HANDITESTER KIT

The small size and rugged construction of this tester makes it perfect for any portable application. The combination function-range switch simplifies operations. Measures AC or DC voltage at 0-10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 (3000 ohm center scale). Very popular with home experimenters, electricians, and appliance repairmen. Slips easily into your tool box, glove compartment, coat pocket, or desk drawer. Shpg. Wt. 3 lbs.

MODEL M-1

$14.50

HEATHKIT PICTURE TUBE CHECKER KIT

The CC-1 can be taken with you on service calls so that you can clearly demonstrate the quality of a customer's picture tube in his own home. Tubes can be tested without removing them from the receiver or cartons if desired. Checks cathode emission, beam current, shorted elements, and leakage between elements in electromagnetic picture tube types. Self-contained power supply, and large 4½" meter. CRT condition indicated on "good-bad" scale. Relative condition of tubes fluorescent coating is shown in "shadowgraph" test. Permanent test cable with CRT socket and anode connector. No tubes to burn out, designed to last a lifetime. Luggage-type portable case. Shpg. Wt. 10 lbs.

MODEL CC-1

$22.50

HEATHKIT ETCHED-CIRCUIT VTVM KIT

This multi-purpose VTVM is the world's largest selling instrument of its type—and is especially popular in laboratories, service shops, home workshops and schools. It employs a large 4½" panel meter, precision 1% resistors, etched metal circuit board, and many other "extras" to insure top quality and top performance. It's easy to build, and you may rely on its accuracy and dependability. The V7-A will measure AC (RMS) and DC voltages in ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. It measures peak-to-peak AC voltage in ranges of 0-4, 14, 40, 140, 400, 1400 and 4000. Resistance ranges provide multiplying factors of X 1, X 10, X 100, X 1000, X 10k, X 100k, and X 1 megohm. Center-scale resistance readings are 10, 100, 1000, 10k, 100k, 1 megohm and 10 megohms. A db scale is also provided. The precision and quality of this VTVM cannot be duplicated at this price. Shpg. Wt. 7 lbs.

MODEL V7-A

$24.50

Heathkits...

By DAYSTROM

let you fill your exact needs from a wide variety of instruments

HEATHKIT 20,000 OHMS/VOLT VOM KIT

This fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a 50 ua 4½" meter, and features 1% precision multiplier resistors. Requires no external power. Ideal for portable applications. Sensitivity is 20,000 ohms-per-volt DC and 5000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts, AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are X 1, X 100 and X 10,000, with center-scale readings of 15, 1500 and 150,000 ohms. Covers −10 db to +65 db. Easy to build and fun to use. Attractive bakelite case with plastic carrying handle. Shpg. Wt. 6 lbs.

MODEL MM-1

$29.50

TUBE CHECKER
High quality test gear you will be proud to own
ETCHED CIRCUIT VTVM
Priced low to fit your budget
HANDITESTER
PICTURE TUBE CHECKER
20,000 OHMS/VOLT VOM

HEATHKIT IMPEDANCE BRIDGE KIT

HEATHKIT RF SIGNAL GENERATOR KIT

Even a beginner can build this prealigned signal generator, designed especially for use in service work. Produces RF signals from 160 kc to 110 mc on fundamentals in five bands. Covers 110 mc to 220 mc on calibrated harmonics. Low impedance RF output in excess of 100,000 microvolts, is controllable with a step-type and continuously variable attenuator. Selection of unmodulated RF, modulated RF, or audio at 400 CPS. Ideal for fast and easy alignment of radio receivers, and finds application in FM and TV work as well. Thousands of these units are in use in service shops all over the country. Easy to build and a real time saver, even for the part-time service technician or hobbyist. Shpg. Wt. 8 lbs.

MODEL SG-8

$19.50

HEATHKIT LABORATORY RF GENERATOR KIT

Tackle all kinds of laboratory alignment jobs with confidence by employing the LG-1. It features voltage-regulated B+, double shielding of oscillator circuits, copper-plated chassis, variable modulation level, metered output, and many other "extras" for critical alignment work. Generates RF signals from 100 kc to 30 mc on fundamentals in five bands. Meter reads RF output in microvolts or modulation level in percentage. RF output available up to 100,000 microvolts, controlled by a fixed-step and a variable attenuator. Provision for external modulation where necessary. Buy and use this high-quality RF signal generator that may be depended upon for stability and accuracy. Shpg. Wt. 16 lbs.

MODEL LG-1

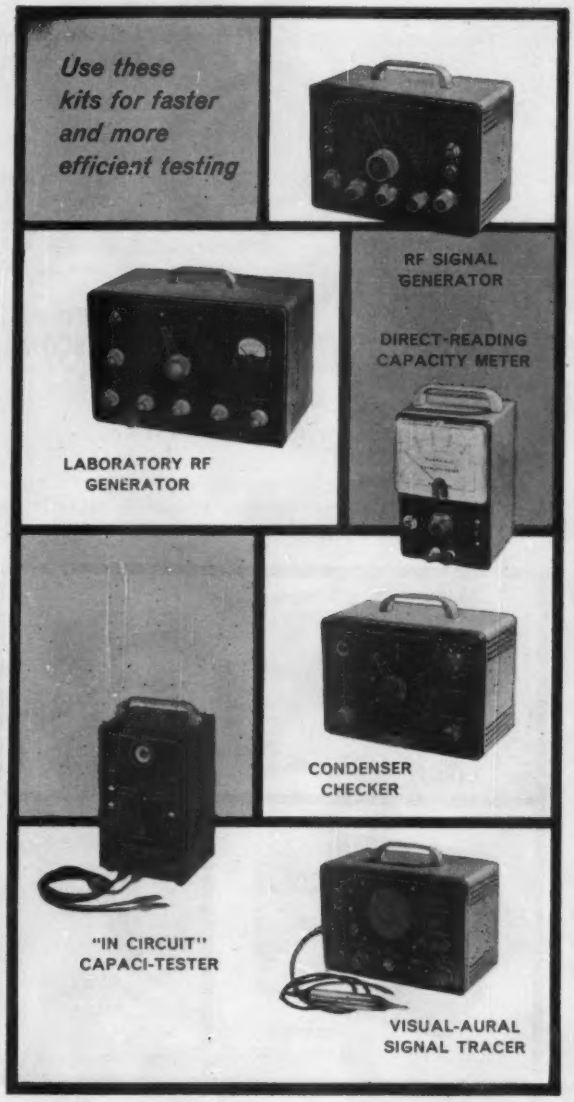
$48.95

HEATHKIT DIRECT-READING CAPACITY METER KIT

Here's a fast, simple capacity meter. A capacitor to be checked is merely connected to the terminals, the proper range selected, and the value read directly on the large 4½" panel meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, .01 mfd, .1 mfd full scale. Not affected by hand capacity. Shpg. Wt. 7 lbs.

MODEL CM-1

$29.50



Heathkits...

By DAYSTROM

are educational as well as functional

HEATHKIT CONDENSER CHECKER KIT

This handy instrument uses an electron beam "eye" tube as an indicator to measure capacity in ranges of .00001 to .005 mfd, .5 mfd, 50 mfd and 1000 mfd. Also measures resistance from 100 ohms to 5 megohms in two ranges. Checks paper, mica, ceramic and electrolytic capacitors. Selection of five polarizing voltages. Shpg. Wt. 7 lbs.

MODEL C-3

$19.50

HEATHKIT "IN-CIRCUIT" CAPACI-TESTER KIT

With the CT-1 it is no longer necessary to disconnect one capacitor lead to check the part, you can check most capacitors for "open" or "short" right in the circuit. Fast and easy—to save your valuable time in the service shop or lab. Detects open capacitors from about 50 mmf up, so long as the capacitor is not shunted by excessively low resistance value. Will detect shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage.) Employs 60 cycles and 19 megacycle test frequencies. Electron beam "eye" tube used as indicator. Compact, easy-to-build, and inexpensive. Test leads included. Shpg. Wt. 5 lbs.

MODEL CT-1

$7.95

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed originally for radio receiver work, the T-3 finds application in FM and TV servicing as well. Features high-gain channel with demodulator probe, and low-gain channel with audio probe. Traces signals in all sections of radio receivers and in many sections of FM and TV receivers. Built-in speaker and electron beam eye tube indicate relative gain, etc. Also features built-in noise locator circuit. Provision for patching speaker and /or output transformer to external set. Shpg. Wt. 9 lbs.

MODEL T-3

$23.50

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT IMPEDANCE BRIDGE KIT

The model IB-2A employs a Wheatstone Bridge, a Capacity Comparison Bridge, a Maxwell Bridge, and a Hay Bridge in one compact package. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 100 mmf to 100 mfd, inductance from 0.1 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. A 100-0-100 ua meter provides for null indications. The decade resistors employed are of 1% tolerance for maximum accuracy. Completely self-contained. Has built in power supply, 1000-cycle generator, and vacuum-tube detector. Special two-section CRL dial insures convenient operation. Instruction manual has entirely new schematic that clarifies circuit functions in various switch positions. A true laboratory instrument, that will provide you with many years of fine performance. Shpg. Wt. 12 lbs.

MODEL IB-2A

$59.50

HEATHKIT "LOW RIPPLE" BATTERY ELIMINATOR KIT

This modern battery eliminator incorporates an extra low-ripple filter circuit so that it can be used to power all the newest transistor-type circuits requiring 0 to 12 volts DC, and the new "hybrid" automobile radios using both transistors and vacuum tubes. Its DC output, at either 6 or 12 volts, contains less than .3% AC ripple. Separate output terminals are provided for low-ripple or normal filtering. Supplies up to 15 amps on 6 volt range or up to 7 amps on 12 volt range. Output is variable from 0 to 8 or 0 to 16 volts. Two meters constantly monitor output voltage and current. Will also double as a battery charger. Shpg. Wt. 23 lbs.

MODEL BE-5

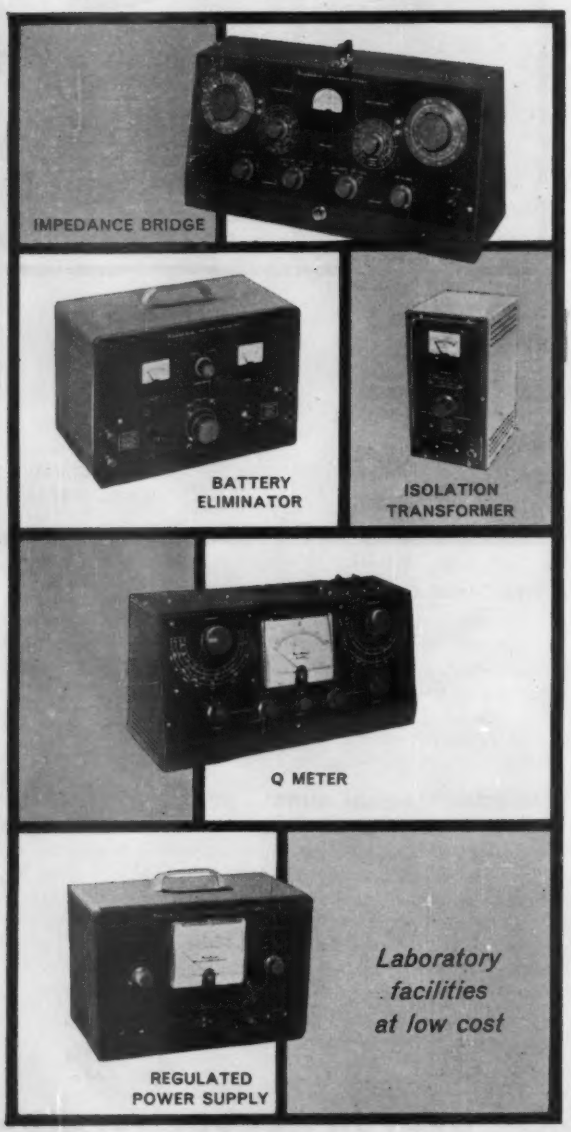
$39.95

HEATHKIT ISOLATION TRANSFORMER KIT

The model IT-1 is one of the handiest units for the service shop, home workshop or laboratory. Provides complete isolation from the power line. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot". Output voltage is variable from 90 volts to 130 volts allowing checks of equipment under adverse conditions such as low line voltage. Rated for 100 volt amperes continuously or 200 volt amperes intermittently. Panel meter monitors output voltage. Shpg. Wt. 9 lbs.

MODEL IT-1

$16.50



Heathkits...

By DAYSTROM

are designed with high-quality, name-brand components to insure long service life

HEATHKIT "Q" METER KIT

At this price the laboratory facilities of a Q Meter may be had by the average service technician or home experimenter. The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenry, "Q" on a scale calibrated up to 250 full scale, with multipliers of 1 or 2, and capacitance from 40 mmf to 450 mmf ± 3 mmf. Built in oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel meter is featured. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed, compile data for coil winding purposes, or measure RF resistance. Also checks distributed capacity and Q of coils. No special equipment is required for calibration. A special test coil is furnished, along with easy-to-follow instructions. Shpg. Wt. 14 lbs.

MODEL QM-1

$44.50

HEATHKIT REGULATED POWER SUPPLY KIT

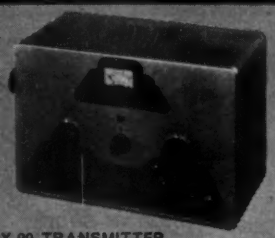
Here is a power supply that will provide DC plate voltage and AC filament voltage for all kinds of experimental circuits. The DC supply is regulated for stability, and yet the amount of DC output voltage available from the power supply can be controlled manually from 0 up to 500 volts. At 450 volts DC output, the power supply will provide up to 10 ma of current, and provide progressively higher current as the output voltage is lowered. Current rating is 130 ma at 200 volts output. In addition to furnishing B+ the power supply also provides 6.3 volts AC at up to 4 amperes for filaments. Both the B+ output and the filament output are isolated from ground. Ideal unit for use in laboratory, home workshop, ham shack, or service shop. A large 4½" meter on the front panel reads output voltage or output current, selectable with a panel switch. Shpg. Wt. 17 lbs.

MODEL PS-3

$35.50

Terrific values in amateur equipment!

DX-100 TRANSMITTER



DX-20 TRANSMITTER

DX-35 TRANSMITTER

HEATHKIT DX-20 CW TRANSMITTER KIT

The Heathkit model DX-20 "straight-CW" transmitter features high efficiency at low cost. It uses a single 6DQ6A tube in the final amplifier stage for plate power input of 50 watts. A 6CL6 serves as crystal oscillator, with a 5U4GB rectifier. It is an ideal transmitter for the novice, as well as the advanced-class CW operator. Single-knob band switching is featured to cover 80, 40, 20, 15, 11 and 10 meters. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long life. It has been given full "TVI" treatment. Access into the cabinet for crystal changing is provided by a removable metal pull-out plug on the left end of the cabinet. Very easy to build from the complete step-by-step instructions supplied, even if you have never built electronic equipment before. If you appreciate a good, clean signal on the CW bands, this is the transmitter for you! Shpg. Wt. 18 lbs.

MODEL DX-20

$35.95

Heathkits...

By DAYSTROM

are designed by licensed ham-engineers, especially for you

HEATHKIT DX-35 PHONE AND CW TRANSMITTER KIT

The DX-35 transmitter can be thought of as the "little brother" of the DX-100. It features both phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 65 watt plate power input on CW, or controlled carrier modulation peaks up to 50 watts for phone operation. Modulator and power supplies are built right in and single knob band switching is combined with a pi network output circuit for complete operating convenience. The tight fitting cabinet presents a most attractive appearance, and is designed for complete shielding to minimize TVI. Back panel control provides convenient switch selection of three different crystals, reached through access door at rear of cabinet. A most remarkable power package for the price. Complete step-by-step instructions with pictorial diagrams to assure your success in assembly. Shpg. Wt. 24 lbs.

MODEL DX-35

$56.95

HEATHKIT DX-100 PHONE AND CW TRANSMITTER KIT

Listen to any ham band between 160 meters and 10 meters and note how many DX-100 transmitters you hear! The number of these fine rigs now on the air testifies to the enthusiasm with which it has been accepted by the amateur fraternity. No other transmitter in this power class combines high quality and real economy so effectively. The DX-100 features a built in VFO, modulator and power supplies, complete shielding to minimize TVI, and pi network output coupling to match impedances from approximately 50 to 600 ohms. Its RF output is in excess of 100 watts on phone and 120 watts on CW, for a clean strong signal on all the ham bands from 10 to 160 meters. Single-knob band switching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as "potted" transformers, silver-plated or solid coin silver switch terminals, aluminum heat-dissipating caps on the final tubes, copper plated chassis, etc. This transmitter was designed exclusively for easy step-by-step assembly. Shpg. Wt. 107 lbs.

MODEL DX-100

$189.50

FUNCTIONAL DESIGN . . .

The transmitters described on this page were designed for the ham, by hams who know what features are desirable and needed. This assures you of the best possible performance and convenience, and adds much to your enjoyment in the ham shack.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT REFLECTED POWER METER KIT

HEATHKIT VARIABLE FREQUENCY

Automatically turns off transmitter and gives visual signal

"AUTOMATIC" CONELRAD ALARM

GRID DIP METER

"Q" MULTIPLIER

COMMUNICATIONS-TYPE RECEIVER

An ideal receiver for the beginning ham or short wave listener

HEATHKIT "AUTOMATIC" CONELRAD ALARM KIT

This conelrad alarm works with any radio receiver; AC-DC-transformer operated—or battery powered, so long as the receiver has AVC. Fully complies with FCC regulations for amateurs. When the monitored station goes off the air, the CA-1 automatically cuts the AC power to your transmitter, and lights a red indicator. A manual "reset" button reactivates the transmitter. Incorporates a heavy-duty six-ampere relay, a thyratron tube to activate the relay, and its own built-in power supply. A neon lamp shows that the alarm is working, by indicating the presence of B+ in the alarm circuit. Simple to install and connect. Your transmitter plugs into an AC receptacle on the CA-1, and a cable connects to the AVC circuit of a nearby receiver. A built-in sensitivity control allows adjustment to various AVC levels. Receiver volume control can be turned up or down, without affecting alarm operation. Build a Heathkit CA-1 in one evening and comply with FCC regulations now! Shpg. Wt. 4 lbs.

MODEL CA-1
$13.95

HEATHKIT "Q" MULTIPLIER KIT

The Heathkit Q Multiplier functions with any AM receiver having an IF frequency between 450 and 460 KC, that is not "AC-DC" type. It derives its power from the receiver, and needs only 6.3 volts AC at 300 ma (or 12 VAC at 150 ma) and 150 to 250 volts DC at 2 ma. Simple to connect with cable and plugs supplied. Adds additional selectivity for separating signals, or will reject one signal and eliminate heterodyne. A tremendous help on crowded phone and CW bands. Effective Q of 4000 for sharp "peak" or "null". Tunes any signal within IF band pass without changing the main receiver tuning dial. A convenient tuning knob on the front panel with vernier reduction between the tuning knob and the tuning capacitor gives added flexibility in operation. Uses a 12AX7 tube, and special high-Q shielded coils. Instructions for connecting to the receiver and operation are provided in the construction manual. A worthwhile addition to any communications, or broadcast receiver. It may also be used with a receiver which already has a crystal filter to obtain two simultaneous functions, such as peaking the desired signal with the crystal filter and nulling an adjacent signal with the Q Multiplier. Shpg. Wt. 3 lbs.

MODEL QF-1
$9.95

HEATHKIT GRID DIP METER KIT

A grid dip meter is basically an RF oscillator for determining the frequency of other oscillators, or of tuned circuits. Extremely useful in locating parasitics, neutralizing, identifying harmonics, coil winding, etc. Features continuous frequency coverage from 2 mc to 250 mc, with a complete set of prewound coils, and a 500 ua panel meter. Front panel has a sensitivity control for the meter, and a phone jack for listening to the "zero-beat." Will also double as an absorption-type wave meter. Shpg. Wt. 4 lbs.

MODEL GD-1B
$19.95

Low Frequency Coil Kit: Two extra plug-in coils to extend frequency coverage down to 350 kc. Shpg. Wt. 1 lb. No. 341-A. $3.00

HEATHKIT ALL-BAND COMMUNICATIONS-TYPE RECEIVER KIT

This communications-receiver covers 550 kc to 30 mc in four bands, and provides good sensitivity, selectivity, and fine image rejection. Ham bands are clearly marked on an illuminated dial scale. Features a transformer-type power supply—electrical band spread—antenna trimmer—headphone jack—automatic gain control and beat frequency oscillator. Accessory sockets are provided on the rear of the chassis for using the Heathkit model QF-1, Q Multiplier. Accessory socket is handy, also, for operating other devices that require plate and filament potentials. Will supply +250 VDC at 15 ma and 12.6 VAC at 300 ma. Ideal for the beginning ham or short wave listener. Shpg. Wt. 12 lbs.

MODEL AR-3
$29.95
(Less cabinet)

Cabinet: Fabric covered cabinet with aluminum panel as shown. Part no. 91-15A. Shpg. Wt. 5 lbs. $4.95.

Heathkits...

By DAYSTROM

are outstanding in performance and dollar value

HEATHKIT REFLECTED POWER METER KIT

The Heathkit reflected power meter, model AM-2, makes an excellent instrument for checking the match of the antenna transmission system, by measuring the forward and reflected power or standing wave ratio. The AM-2 is designed to handle a peak power of well over 1 kilowatt of energy and may be left in the antenna system feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances for 50 or 75 ohm lines. No external power required for operation. Meter indicates percentage forward and reflected power, and standing wave ratio from 1:1 to 6:1. Another application for the AM-2 is matching impedances between exciters or R.F. sources and grounded grid amplifiers. Power losses between transmitter output and antenna tuner may be very easily computed by inserting the AM-2 in the line connecting the two. No insertion loss is introduced into the feeder system, due to the fact that the AM-2 is a portion of coaxial line in series with the feeder system and no internal connections are actually made to the line. Complete circuit description and operation instructions are provided in the manual. Cabinet size is 7-3/8" x 4-1/16" x 4-5/8". Can be conveniently located at operating position. Shpg. Wt. 3 lbs.

MODEL AM-2

$15.95

HEATHKIT VARIABLE FREQUENCY OSCILLATOR KIT

Enjoy the convenience and flexibility of VFO operation by obtaining the Heathkit model VF-1 Variable Frequency Oscillator. Covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10 volt average RF output on fundamentals. Plenty of output to drive most modern transmitters. It features voltage regulation for frequency stability. Dial is illuminated for easy reading. Vernier reduction is used between the main tuning knob and the tuning condenser. Requires a power source of only 250 volts DC at 15 to 20 miliamperes and 6.3 volts AC at 0.45 amperes. Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts throughout. VFO operation allows you to move out from under interference and select a portion of the band you want to use without having to be tied down to only two or three frequencies through use of crystals. "Zero in" on the other fellow's signal and return his CQ on his own frequency! Crystals are not cheap, and it takes quite a number of them to give anything even approaching comprehensive coverage of all bands. Why hesitate? The model VF-1 with its low price and high quality will add more operating enjoyment to your ham activities. Shpg. Wt. 7 lbs.

MODEL VF-1

$19.50*

Heathkits...

By DAYSTROM

are the answer for your electronics hobby.

HEATHKIT BALUN COIL KIT

The Heathkit Balun Coil Kit model B-1 is a convenient transmitter accessory, which has the capability of matching unbalanced coax lines, used on most modern transmitters, to balance lines of either 75 or 300 ohms impedance. Design of the bifilar wound balun coils will enable transmitters with unbalanced output to operate into balanced transmission line, such as used with dipoles, folded dipoles, or any balanced antenna system. The balun coil set can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will easily handle power inputs up to 250 watts. Cabinet size is 9" square by 5" deep and it may be located any distance from the transmitter or from the antenna. Completely enclosed for outdoor installation. Shpg. Wt. 4 lbs.

MODEL B-1

$8.95

HEATHKIT 6 OR 12 VOLT VIBRATOR POWER SUPPLY KITS

These little power supply kits are ideal for all portable applications with 6 volt or 12 volt batteries, when you are operating electronic equipment away from power lines. By replacing the power supplies of receivers, small public address systems, or even miniature transmitters with these units, they can be used with conventional 6 or 12 volt batteries. Use in boats, automobiles, light aircraft, or any field application. Each unit provides 260 volts DC output at up to 60 miliamperes. More than one power supply of the same model may be connected in parallel for increased current capacity at the same output voltage. Everything is provided in the kit, including a vibrator transformer, a vibrator, 6X4 or 12X4 rectifier, and the necessary buffer capacitor, hash filter, and output filter capacitor. Shpg. Wt. 4 lbs.

6 VOLT MODEL VP-1-6
12 VOLT MODEL VP-1-12

$7.95 Each*

REFLECTED POWER METER
Insure your "on the air" performance with these fine accessories.
VARIABLE FREQUENCY OSCILLATOR
VIBRATOR POWER SUPPLY
BALUN COIL SET

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT ELECTRONIC IGNITION ANALYZER KIT

Previous electronic experience is not necessary to build this fine ignition analyzer. The construction manual supplied has complete step-by-step instructions plus large pictorial diagrams showing the exact placement and value of each component. All parts are clearly marked so that they are easily identified. The IA-1 is an ideal tool for engine mechanics, tune-up men, and auto hobbyists, since it traces the dynamic action of voltage in an ignition system on a cathode-ray tube screen. The wave form produced is affected by the condition of the coil, condenser, points, plugs, and ignition wiring, so it can be analyzed and used as a "sign-post" to ignition system performance. This analyzer will detect inequality of spark intensity, a poor spark plug, defective plug wiring, breaker-point bounce, an open condenser, and allow setting of dwell-time percentage for the points. An important feature of this instrument is its ability to check dynamic performance, with the engine in operation (400 to 5000 RPM). It will show the complete engine cycle, or only one complete cylinder. Can be used on all types of internal combustion engines where breaker-points are accessible. Use it on automobiles, boats, aircraft engines, etc. Shpg. Wt. 18 lbs.

MODEL IA-1
$59.95

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This Heathkit professional-type radiation counter is simple to build successfully, even if you have never built a kit before. Complete step-by-step instructions are combined with giant-size pictorial diagrams for easy assembly. By "building it yourself" you can have a modern-design, professional radiation counter priced far below comparable units. Provides high sensitivity with ranges from 0-100, 600, 6000 and 60,000 counts-per-minute, and 0-.02, .1, 1 and 10 milliroentgens-per-hour. Employs 900-volt bismuth tube in beta/gamma sensitive probe. Probe and 8-foot expandable cable included in kit price, as is a radiation sample for calibration. Use it in medical laboratories, or as a prospecting tool, and for civil defense to detect radioactive fallout, or other unknown radiation levels. Features a selectable time constant. Meter calibrated in CPM or mR/hour in addition to "beep" or "click" from panel-mounted speaker. Prebuilt "packaged" high voltage power supply with reserve capacity above 900 volt level at which it is regulated. Merely changing regulator tube type would allow use of scintillation probe if desired. Employs five tubes (plus a transistor) to insure stable and reliable operation. Kit price includes batteries. Shpg. Wt. 8 lbs.

MODEL RC-1
$79.95

Heathkits...

By DAYSTROM

are supplied with comprehensive instructions that eliminate costly mistakes and save valuable time

HEATHKIT ENLARGER TIMER KIT

The ET-1 is an easy-to-build electronic device to be used by amateur or professional photographers in timing enlarger operations. The calibrated dial on the timer covers 0 to 1 minute, calibrated in 5-second gradations. The continuously variable control allows setting of the "on" cycle of your enlarger, which is plugged into a receptacle on the front panel of the ET-1. A "safe light" can also be plugged in so that it is automatically turned "on" when the enlarger is turned "off." Handles up to 350 watts with built-in relay. All-electronic timing cycle insures maximum accuracy. Timer does not have to be reset after each cycle, merely flip lever switch to print, to repeat time cycle. A control is provided for initial calibration. Housed in a compact plastic case that will resist attack of photographic chemicals. A fine addition to any dark room. Shpg. Wt. 3 lbs.

MODEL ET-1
$11.50

HEATHKIT BATTERY TESTER KIT

The BT-1 is a special battery testing device that actually "loads" the battery under test (draws current from it) while it is being tested. Weak batteries often test "good" with an ordinary voltmeter but the built-in load resistance of the BT-1 automatically draws enough current from the battery to reveal its true condition. Simple to operate with "good-weak-replace" scale. Tests all kinds of dry cell batteries within ranges of 0-15 volts and 0-180 volts. Slide switch provides for either 10 ma or 100 ma load, depending on whether you're testing an A or B battery. Not only determines when battery is completely exhausted, but makes it possible to anticipate failure by noting weak condition. Ideal for testing dry cell hearing aid, flashlight, portable radio, and model airplane batteries. Test batteries in a way your customers can understand and stimulate battery sales. Shpg. Wt. 2 lbs.

MODEL BT-1
$8.50

CRYSTAL RADIO
Now you can have radio wherever you go — with the portable that plays anywhere!
BROADCAST BAND RADIO
TRANSISTOR PORTABLE

HEATHKIT CRYSTAL RADIO KIT

The Heathkit model CR-1 crystal radio is similar to the "crystal sets" of the early radio days except that it has been improved by the use of sealed germanium diodes and efficient "high-Q" coils. The sealed diodes eliminate the critical "cats whisker" adjustment, and the ferrite coils are much more efficient for greater signal strength. Housed in a compact plastic box, the CR-1 uses two tuned circuits, each with a variable tuning capacitor, to select the local station. It covers the broadcast band from 540 to 1600 kc. Requires no external power whatsoever. This receiver could prove valuable to emergency reception of civil defense signals should there be a power failure. The low kit price even includes headphones. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. The instruction manual also provides the builder with the basic fundamentals of signal reception so that he understands how the crystal receiver functions. An interesting and valuable "do-it-yourself" project for all ages. Shpg. Wt. 3 lbs.

MODEL CR-1
$7.95

Heathkits...
By DAYSTROM

are easy and fun to build, and they let you learn by "doing-it-yourself"

HEATHKIT TRANSISTOR PORTABLE RADIO KIT

Heath engineers set out to develop a "universal" AM radio, suitable for use anywhere. Their objective was a portable that would be as much "at home" inside as it is outside, and would feature top quality components for high performance and long service life. The model XR-1 is the result of these efforts. Six name-brand (Texas Instrument) transistors were selected for extra good sensitivity and selectivity. A 4" by 6" PM speaker with heavy magnet was chosen to insure fine tone quality. The power supply was designed to use six standard size "D" flashlight cells because they are readily available, inexpensive, and because they afford extremely long battery life (between 500 and 1000 hours). Costs you no more to operate from batteries than what you pay for operating a small table-model radio from the power line. An unbreakable molded plastic was selected for cabinet material because of its durability and striking beauty. Circuit is compact and efficient, yet components are not excessively crowded. Transformers are prealigned so it is ready for service as soon as construction is completed. Has built in rod-type antenna for reception in all locations. Cabinet dimensions are 9" L x 8" H x 3¾" D. Comes in holiday gray, with gold-anodized metal speaker grille. Compare this portable, feature by feature, to all others on the market, and you'll appreciate what a tremendous dollar value it represents! Shpg. Wt. 4 lbs.

MODEL XR-1
$34.95
(Less batteries)
(With cabinet)

HEATHKIT BROADCAST BAND RADIO KIT

This table-model broadcast radio is fun to build, and is a fine little receiver for your home. It covers the standard broadcast band from 550 to 1600 kc with good sensitivity and selectivity. The 5½" PM speaker provides surprisingly good tone quality. High-gain IF transformers, miniature tubes, and a rod-type built in antenna, assure good reception in all locations. The power supply is transformer operated, as opposed to many of the economy "AC-DC" types. It's easy to build from the step-by-step instructions, and the construction manual includes information on operational theory, for educational purposes. Your success is assured by completely detailed information which also explains resistor and capacitor color codes, soldering techniques, use of tools, etc. A signal generator is recommended for final alignment. Shpg. Wt. 10 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Shpg. Wt. 5 lbs. Part no. 91-9A. $4.95.

MODEL BR-2
$18.95
(Less cabinet)

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

protects against possible explosion and fire from undetected fuel vapor
FUEL VAPOR DETECTOR
detects electrolysis currents which cause deterioration of underwater metal fittings on your boat
ELECTROLYSIS DETECTOR
indicates condition and charge of batteries for safe cruising
BATTERY CHARGE INDICATOR
R.F. POWER METER

HEATHKIT FUEL VAPOR DETECTOR KIT

Protect your boat and its passengers against fire or explosion from undetected fuel vapor by building and using one of these fine units. The Heathkit Fuel Vapor Detector indicates the presence of fumes on a three-color "safe-dangerous" meter scale and immediately shows if it is safe to start the engine. A pilot light on the front panel shows when the detector is operating, and it can be left on continuously, or just used intermittently. A panel control enables initial calibration of the detector when installed. Features a hermetically-sealed meter with chrome bezel, and a chrome-plated brass panel. It is very simple to build and install, even by one not having previous experience. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from your boat batteries. The kit is complete in every detail, even to the inclusion of a spare detector unit. Shpg. Wt. 4 lbs.

6 volt MODEL FD-1-6
12 volt MODEL FD-1-12
$35.95 EACH

HEATHKIT BATTERY CHARGE INDICATOR KIT

The Heathkit model CI-1 Marine Battery Charge Indicator has been designed especially for the boat owner, although it has found use in service stations, power stations, and radio stations where banks of batteries are kept in reserve for emergency power. It is intended to replace the hydrometer method of checking storage batteries, and to eliminate the necessity for working with acid in small, below-decks enclosures. Now it is possible to check as few as one, or as many as eight storage batteries, merely by turning the switch and watching the meter. A glance at the meter tells you instantly whether your batteries are sufficiently charged for safe cruising. Dimensions are 2-7/8"W x 5-11/16" H x 2" D. Operates on either 6 or 12 volt systems using lead-acid batteries, regardless of size. Simple installation can be accomplished by the boat owner in fifteen minutes. Shpg. Wt. 3 lbs.

MODEL CI-1
$16.95

HEATHKIT ELECTROLYSIS DETECTOR KIT

The Heathkit model ED-1 Electrolysis Detector indicates the extent of electrolysis currents between the boat's common ground and underwater fittings, except on boats having metal hulls. These currents, undetected, could cause gradual corrosion and deterioration of the propeller or other metal fittings below the water line. It is particularly helpful when installing electrical equipment of any kind, or to determine proper polarity when power is obtained from a shore supply. Easy to-build, the model ED-1 consists of a hermetically-sealed, waterproof meter, special sensing plate, and sufficient wire to install, including the necessary hardware. Mounts on instrument panel where it can be easily seen. Requires no power for operation, and gives instant warning to guard your boat for a lifetime. Shpg. Wt. 2 lbs.

MODEL ED-1
$9.95

HEATHKIT RF POWER METER KIT

The Heathkit RF Power Meter Kit is designed to sample the RF field in the vicinity of your transmitter, whether it be marine, mobile, or fixed. Output meter is merely placed in some location close to the transmitter, to pick up RF radiation from the antenna. Requires no batteries, electricity, nor direct connection to the transmitter. It provides you with a continuing indication of transmitter operation. You can easily detect if power is dropping off by comparing present meter readings with past ones. Operates with any transmitter having output frequencies between 100 kc and 250 mc, regardless of power. Sensitivity is 0.3 volts RMS full scale, and a special control on the panel allows for further adjustment of the sensitivity. Meter is a 200 ua unit, mounted on a chrome-plated brass panel. The entire PM-1 measures only 3¾" W x 6¼" L x 2" D. An easy way to put your mind at ease concerning transmitter operation. Shpg. Wt. 2 lbs.

MODEL PM-1
$14.95

Heathkits...

By DAYSTROM

now offer you completely modern marine equipment with outstanding design features

HEATHKIT TRANSISTOR RADIO DIRECTION FINDER KIT

The Heathkit Transistor Radio Direction Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit). The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅞" H x 5¾" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 5 lbs.

MODEL DF-1

$49.95

(Available after November 15)

TRANSISTOR
RADIO DIRECTION FINDER

Heathkits...

By DAYSTROM

are sold only by direct mail, passing middleman profits on to you

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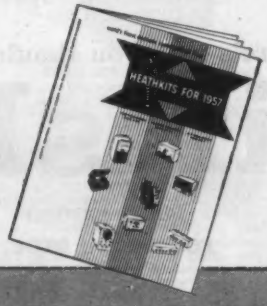
The Heath Company maintains a technical consultation service, should you experience some sort of difficulty in construction or operation. Although only a very small percentage of our customers ever have occasion to use this service (usually only beginners in electronics) it is still reassuring to know that technical help is available when needed. A service department is also available, should you wish a complete factory check of operation and alignment or repair. After you build your first Heathkit you'll realize how easy it is.

Free Catalog

Send for this informative booklet listing more than 100 "do-it-yourself" kits.



HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 15, MICH.**

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Please ship C.O.D. ( ) postage enclosed for_____pounds.

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It's the best-engineered tape in the world...gives you better highs...better lows...better sound all around! Saves your tape recorder, too – because the **irish** FERRO-SHEEN process results in smoother tape...tape that can't sand down your magnetic heads or shed oxide powder into your machine. Price? Same as ordinary tape!

Available wherever quality tape is sold.
ORRadio Industries, Inc., Opelika, Alabama
Export: Morhan Exporting Corp., New York, N.Y.
Canada: Atlas Radio Corp., Ltd., Toronto, Ontario

Hi-Fi-Audio Product Review

HEATH 70-WATT AMPLIFIER

Heath Company of Benton Harbor, Mich. has added a 70-watt unit to its line of high-fidelity amplifiers in kit form.

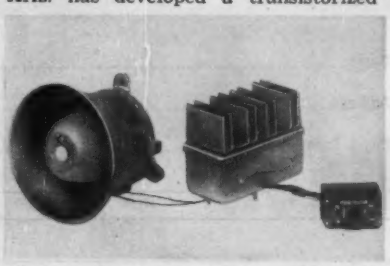
The Model W-6M's circuit uses 6550 output tubes and a special *Peerless* output transformer for minimum distortion and maximum stability. Special driver circuitry prevents amplifier break-up at extreme power peaks. The power supply uses silicon-diode rectifiers which are noted for long service and low resistance. The heavy duty power supply plus the rectifiers insure good regulation.

A calibration control varies the damping factor from .5 to 12 at all output taps and sets amplifier conditions to the optimum value for any given speaker system. A quick-change plug selects 4, 8, and 16 ohms or 70-volt output and the correct feedback resistance. A built-in meter reads plate current for the power amplifier tubes and indicates when the 6550's are in balance.

Write the manufacturer for full details and price on this new amplifier.

SIREN-P.A. SYSTEM

Electronic Engineering Enterprises, 116 W. Indian School Road, Scottsdale, Ariz. has developed a transistorized siren and p.a. system combination which has been designed especially for law enforcement and Civil Defense applications.



The sound of the "Penetrator" is similar to that of a mechanical siren but is louder and more penetrating. It is fully automatic and has no vibration, requires less battery drain, and has no moving parts. The unit is supplied complete with speaker, amplifier, control panel, and all cables. The p.a. feature is selectable by means of a switch on the control panel. The system is available for both 6- and 12-volt automotive battery systems or for installation on motorcycles.

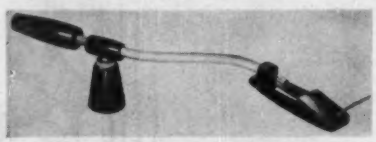
Write the company direct for a copy of a data sheet which gives full details and ordering instructions.

DAMPED TONE ARM

Intersearch Corp., 7 Arcadia Place, Cincinnati 8, Ohio is now marketing a Japanese-made tone arm which was designed for the firm by Charles Boegli of Cincinnati.

Lateral viscous damping (silicone oil) soaks up resonances, aids tracking while the extremely low vertical inertia permits safe use of cartridges with low vertical compliance.

Adjustable horizontal static balancing reduces the effect of floor vibrations and minimizes groove jumping. The arm will accommodate all standard-mounting cartridges, including the high compliance models. There is negligible tracking error. The arm itself features modern functional styling and will handle records up to 16 inches in diameter.



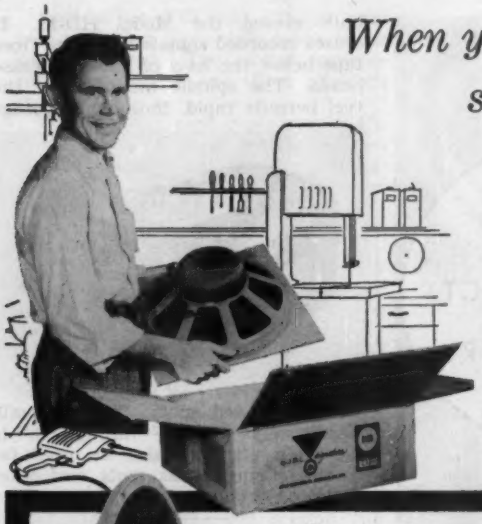
AUDIO ITEMS FROM MICROTRAN

Microtran Company, Inc., 145 E. Mineola Ave., Valley Stream, N. Y. has recently released two new audiophile items of interest to the trade.

The first is a hi-fi multiple speaker matching and level adjusting transformer which is designed especially for the audiophile who is modifying or enlarging his sound system by the addition of auxiliary speakers, equalizers, crossover networks, etc. The unit permits system changes to be made without unbalancing the present system by maintaining required impedance matches and power levels.

The transformer has a power level of 50 watts and 100 watts peak, frequency response is 15 to 30,000 cps, power level adjustment can be made in 3 db steps, impedance matching range is 16, 8, 4 ohms, one- to three-speaker systems in any combination. The transformer comes with a hook-up chart.

The second item is a magnetic tape



When you build your High Fidelity sound system, use THE VERY BEST LOUDSPEAKERS YOU CAN GET

You are planning to build, or improve, your high fidelity sound system. Unstintingly, you will pour out your enthusiasm, time, and energy to get the finest music reproduction you can bring into your home. Get a loudspeaker that will do full credit to your handiwork... Install a JBL Signature Extended Range Loudspeaker, or two-way speaker system, in your enclosure.

JBL Signature Loudspeakers are made with the same careful craftsmanship, the same precision forming and fitting that you yourself would use if you set out to make the finest loudspeaker the world had ever heard. JBL Signature precision speakers are the most efficient loudspeakers made.

With a JBL Signature Loudspeaker in your high fidelity system, you can exhibit your components with pride, confident that those you have made yourself are being demonstrated in the most effective way possible.

MODEL D130—15" extended range loudspeaker The only 15" extended range speaker made with a 4" voice coil is the world-famous JBL Signature D130. The large voice coil stiffens the cone for crisp, clean bass; smooth, extended highs. Your basic speaker, the D130 works alone at first, later becomes a low frequency driver when you add a JBL Signature high frequency unit and dividing network to achieve the ultimate excellence of a JBL Signature two-way system.

MODEL D123—12" extended range loudspeaker With outstanding "presence" and clean response throughout the entire audio spectrum, the D123 features an unusual shallow construction. Only 3⅝" deep, it is designed to mount flush with the wall, between studding, in any standard wall or partition. Frequently, the D123 is used in multiples in "infinite baffle" wall installations. In this case the JBL Signature 075 is a logical high frequency unit to add when you advance to a two-way system.

MODEL D208—8" extended range loudspeaker A precision transducer in every sense of the word, the famed JBL Signature 8" D208 is made with the same care and precision as the larger units in the James B. Lansing Sound, Inc., line. If space and cost are major considerations, the D208, properly enclosed, provides the most lastingly satisfactory sound you can get. It is widely used in top quality systems where extension speakers are desired for areas other than the main listening room.

MODEL 175DLH high frequency assembly The acoustical lens is only available on JBL Signature high frequency units. The 14 element lens on the 175DLH disperses sound within the listening area over a 90° solid angle, smoothly, with equal intensity regardless of frequency. The acoustical lens is the greatest contribution to lifelike high frequency reproduction in 20 years, and it was developed for use with high fidelity equipment by James B. Lansing Sound, Inc. In addition to the lens, the 175DLH consists of a high precision driver with complex phasing plug and a machined aluminum exponential horn. Designed for crossover at 1200 cycles with the JBL Signature N1200 Network.

MODEL 075 high frequency unit Another exclusive for James B. Lansing Sound, Inc. is the ring radiator in the JBL Signature 075 high frequency unit. A ring, rather than a diaphragm, radiates into the annular throat of an exponential horn. The result is high frequency reproduction of unmatched smoothness and clarity, absolutely free of resonances and strident peaks. The horn is beautifully machined from aluminum, the entire unit a gratifying, solid piece of fine craftsmanship. Designed for crossover at 2500 cycles with the JBL Signature N2500 Network.

JBL Signature two-way systems are available as kits

086 KIT This two-way system is made up of units which have been acclaimed by impartial authorities as the finest available anywhere today. Included in the kit are the 150-4C Low Frequency Driver, N500H Network, 375 High Frequency Driver, 537-509 Horn-Lens Assembly. These are the same units—including the serpentine acoustical lens—which are used in The Hartsfield... units designed originally for installation in the most modern theaters in the world.

002 KIT Including some of the newest speakers made, the JBL Signature 002 Kit includes a D123 for low frequency reproduction, N2500 Network, 075 High Frequency Unit. The 002 Kit is moderately priced, yet gives the user all the advantages of a two-way system made with independent drivers.

001 KIT Probably the most popular high quality two-way system on the market, the JBL Signature 001 system consists of a 130A Low Frequency Driver, N1200 Network, 175DLH High Frequency Assembly. The D130 may be substituted for the 130A without disturbing the balance or coverage of the system.

There are many more kits and loudspeakers in the JBL Signature line. Whatever your needs, you will find exactly the right unit or system in the complete JBL Signature catalog. Send for your free copy. A limited number of technical bulletins are also available. Please ask only for those in which you are vitally interested.

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☐ D130 ☐ D123 ☐ D208 ☐ 175DLH ☐ 075 ☐ 130A ☐ 150-4C

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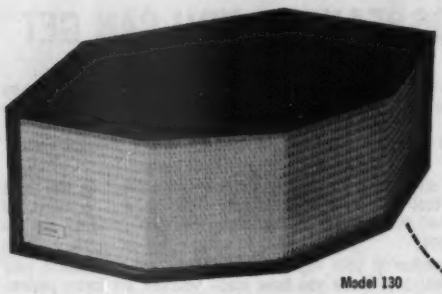
JansZen *Electrostatic*



THE MOST NEARLY PERFECT LOUDSPEAKER

Model 130

JansZen DYNAMIC

A NEW STANDARD IN CONE WOOFERS

Model 250 measures only 18¾" high (exclusive of legs) by 24¾" wide by 14" deep

A COMPLETE RANGE LOUDSPEAKER SYSTEM

Model Z-200 measures only 32" high (including 4" legs) by 24¾" wide by 14" deep

NOW more than ever...

Hear the Music, not the Speaker

Write for literature and the name of your nearest dealer

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Export Division: 25 Warren Street, N.Y.C. 7 • Cable Simontrice, N.Y.

bulk eraser, the Model HD-11. It erases recorded signals and noise from tape below the level of standard erase heads. The spindle mounting of the reel permits rapid, thorough coverage

without missed spots. The unit will handle reels from 5" through 10" in diameter. It may also be used for demagnetizing heads, tools, and other metal objects.

NEW "LOW-PRINT" TAPE

Minnesota Mining and Manufacturing Co., 900 Bush Street, St. Paul 6, Minn. has announced the availability of a new magnetic tape for the critical professional user.

The "Scotch" No. 131 "Low-Print" reduces print level by 8 db and increases frequency response. In addition, through use of the company's "high potency" oxide in a thin coating, the new tape provides an improvement in short wavelength response of 2 db as compared with conventional tapes, with no loss in low-frequency performance.

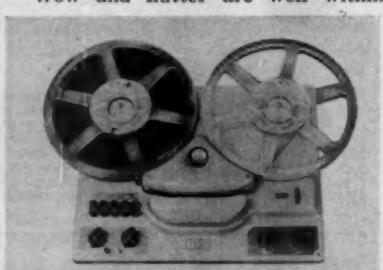
The tape is packed in a grey box marked "for professional use" and can be identified by a gold "Low-Print" seal on the cover.

"REVOX" TAPE RECORDERS

Electronics Applications, 150 East 35th St., New York, N. Y. is handling the distribution of the new "ReVox" tape recorders in this country.

The Model B-36-1 single-track and Model B-36-2 dual-track units feature three motors, separate recording and playback toroid heads, separate recording and playback amplifiers, an 8" coaxial speaker, and turret-assembly wiring.

Wow and flutter are well within



NARTB professional standards for studio machines at 7.5 ips, .15 to .20 per-cent r.m.s. maximum measured at either 5000 or 3000 cps and including all sources. Frequency response at 7.5 ips (1000 cps reference) is 40 to 12,000 cps +1, —2 db, roll-off to 15,000 cps under —5 db.

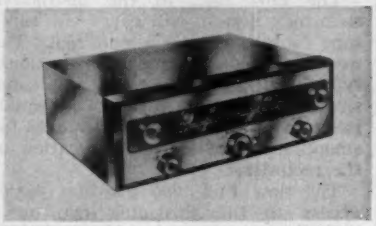
Speeds are 3.75 and 7.5 ips with pole-switching hysteresis synchronous capstan driver. The circuit incorporates eight tubes and three selenium rectifiers.

The carrying case measures 18⅛"x 11$\frac{1}{16}$"x13⅜". A rack console version is also available for custom installation. Write V. J. Skee of the firm for free literature.

AM-FM TUNER FOR STEREO

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. is now offering an AM-FM tuner designed for stereo reception.

Incorporating separate FM and AM sections, the unit can also be used for dual monaural or straight monaural reception. Each section has its own 3-gang, flywheel tuning capacitor and separate volume controls. The tuner features 12 tuned circuits. There are four i.f. stages plus a Foster-Seeley discriminator in the FM section and two i.f. stages plus a tuned r.f. stage in the AM section. There are dual



double-tuned transformer-coupled limiters.

Frequency response is 20 to 20,000 cps ± ½ db. Harmonic distortion is less than 1% on FM and less than 1% on AM for 80% modulation. Hum level is 60 db below 100% modulation. FM drift is ± 5 kc. maximum.

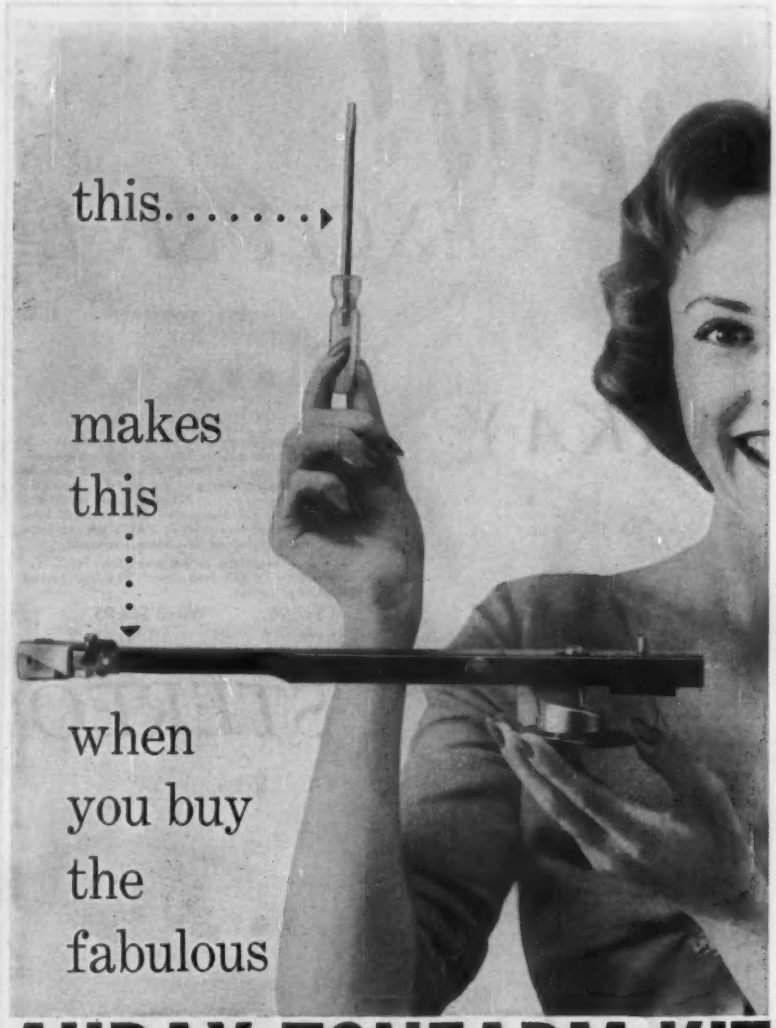
Featuring separate printed circuit board construction, the new tuner is available in kit form as the KT-500 or fully wired as the LT-50.

NEW ASTATIC ITEMS

The Astatic Corporation, Conneaut, Ohio has announced the development of three new subminiature cartridges and a wide-range ceramic plug-in cartridge-needle combination.

The subminiature "Climatite" cartridges are designed for narrow arm record changers and are available in three models. The 120TS features an output of 3 volts with a frequency range of 30 to 11,000 cps; the 118TS has an output of .75 volt and a frequency range of 30 to 13,000 cps and a compliance of 1.2; the 124TS is a replacement unit for *Philco* changers and features an output of 3 volts and a frequency range of 30 to 11,000 cps. Catalogue 33-2, available from the company, contains complete information on these three new cartridges.

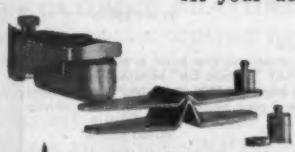
The second item, tradenamed "Soundflow," has been designed as an original and direct replacement for ceramic cartridge applications. It consists of two components—the holder with "Turnunder" lever mounts on 7/16" and ½" centers which fit any standard manual or changer arm. The



AUDAX TONEARM KIT

A screwdriver... 15 minutes of your time... and the fabulous Audax tonearm kit — that's all you need to own your own compass-pivot Audax Professional Tonearm *at a big saving!* You'll find accurate assembly of this exclusive kit a very simple affair — with assurance that the final result will be as fine as factory-assembled units! Use any cartridge with your Audax arm. Thrill to the wonderful new difference it makes in your high fidelity system — a difference that confirms your wise choice in owning one of the finest tonearms ever made!

At your dealer { 12" Tonearm Kit **$14.55**
16" Tonearm Kit $17.55



BEST RECORD PROTECTION INSURANCE—
Audax "Micro-poise"... the gram weight scale with "prescription" accuracy! $3.95

AUDAX Div. of Rek-O-Kut Co., Inc., 38-19 108 St., Corona 68, N. Y.

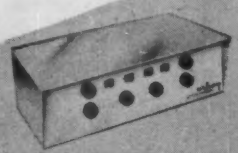
NEW! EXCLUSIVE

ARKAY

ST-11—a binaural tuner designed to provide the listener with stereo Hi-Fi of exceptional quality. Because each section contains own tuning condenser I.F. strip, detector and cathode follower outputs, monaural tuning of AM or FM is possible. Arkay "Miracle Ear" sensitivity on FM gives 4 mv. for 20 db. quieting: Bandwidth 200 KC, 6 db. down: freq. resp. ±.5db. 20 to 20,000 cycles: Hum level—65 db.: AFC: adj. cathode follower output: 75 microsecond de-emphasis network.

Arkay "Miracle Ear" sensitivity on AM gives 3mv. for 20 db. quieting: Bandwidth — 8 KC: freq. resp. 20-8,000 cycles: adj. cathode follower output.

Kit $47.95 Wired $69.95



SP-6—Dual channel, preamp with cathode follower outputs. Can be used with tape deck, mag. phono, tuner, or aux. equipment. The construction of the SP-6 allows for use as a conventional pre-amp. Features include 6 position func. switch: Simultaneous volume control: Loudness control: Bass control ± 16 db. @ 60 cps: Treble control ± 16 db. @ 10,000 cycles: 3 position Hi-filter and Lo-filter: Freq. response ± .5 db. 20 to 40,000 cps. Sensitivity—tape, 4 mv. for .5 volt output—phono, 6 mv. for .5 volt output—tuner and aux. .3 volt for .5 volt output: DC fil.: Built-in power supply:

Kit $34.95 Wired $47.95

STEREO

HI - FI

KITS AND PREWIRED

Prices 5% Higher West of Mississippi

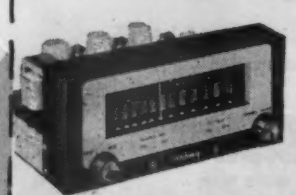
MODEL SA-25—dual channel pre-amp drives a monaural 25 watt Linear Williamson amp. with your present amplifier for unsurpassable realism of Binaural sound.

Channel 1—25 watt amp: freq. resp. —± 2 db. @ 20 watts, 20 to 20,000 cycles: sens. tape phono—4 mv. for 20 watts: tuner aux.—.3V for 25 watts: Loud. Control: Volume Control —controls dual channels: Bass Control and Treble Control 2 pos. "Lo-Cut" and "Hi-Cut" filters: Equal. switch for all labels plus NARTB tape head.

Channel 2—.5V output—same sens. as channel 1: same pre-amp. features. Just add your present Hi-Fi amp. to channel 2 and prepare yourself to enjoy the sound reproduction only ARKAY stereo can offer.

Kit $59.95 Wired $89.95

new



ARKAY FM-8—FM TUNER

The standard of the professionals—engineered for precise FM reception ARKAY "Miracle Ear" sensitivity allows 1.9 uV. for 20 db. s/n. Frequency response 20 to 20,000 cps. 3 tuned RF stages: Dual limiters: Armstrong FM—Foster Seeley discriminator: Variable AFC: Silent tuning system: Tuning meter: Cathode follower, high level and binaural FM (Multiplex) outputs: 0-100 logging scale for station pinpointing: Self contained AC power supply

Kit $39.95 Wired $59.95

ARKAY AM-5—AM TUNER

This new "AM-5" is the most sensitive tuner ever designed for Hi-Fi AM reception, ARKAY "Miracle Ear" sensitivity gives 2 uV. for 20 db s/n Wide band (20-8500 cps.) and Narrow band (20-3500 cps.) reception 3 gang tuning condenser: 10 Kc. whistle filter

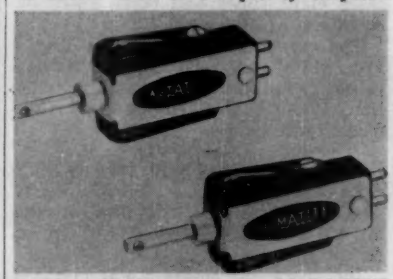
Kit $23.45 Wired $35.95

Get the new, big catalogue and specifications of the remarkable ARKAY radio, Hi-Fi and TV line Now at your local dealer!

ARKAY 120 CEDAR STREET NEW YORK 6, N. Y.

cartridge-needle combination plugs in or out of the holder.

Output is 1.3 volts and compliance is better than 2. Frequency response



is 30 to 15,000 cps for the Model 89TB while the Model 81TB has a frequency response of 30 to 15,000 cps, output of 1 volt, and compliance better than 1.

5¾-INCH REEL

ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala. has recently introduced a new 5¾ inch reel to carry its "Irish Brand" tape.

The new reel, in the distinctive shamrock design, will carry the same tape footage as the 5-inch reel. The new reel, however, has a professional type hub (2¼" diameter), the same size hub as the 7-inch reel. This equalizes tension on the tape and makes for smoother, more efficient operation of the recorder.

The new reel also provides easier access to the threading eye by a larger opening in the reel. An added convenience is 24 square inches of indexing space on the two sides. The reel also incorporates the "No Spill" feature.

SUPER POWER DRIVERS

University Loudspeakers, Inc., White Plains, N. Y. has announced two new driver units which are said to have the highest continuous duty power capacity of any p.a. units.

The Model PA-HF utilizes a watertight, all die-cast aluminum housing for lifetime resistance to physical abuse. It is recommended for applications requiring maximum power han-

dling capacity, maximum sensitivity, and wide frequency response (70 to 10,000 cps).

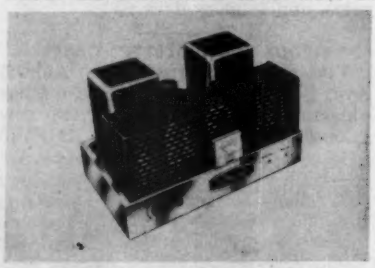
The Model PA-50 uses the same internal mechanism as the PA-HF but includes a heavy duty, multi-impedance line matching transformer built into the driver housing. Input terminals at the watertight base of the driver are marked directly in impedances of 100/165/250/500/1000/2000 ohms and in 70-volt power taps of 50/30/20/10/5/2.5 watts when used in constant-voltage systems.

Both drivers have continuous-duty, full-range capacity of 50 watts and a continuous-duty adjusted range capacity of 100 watts. The higher rating is achieved by limiting the frequency response of input to a range above the cut-off frequency of the associated trumpet.

HIGH-POWER AMPLIFIER

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. has added a Brociner-designed, 70-watt amplifier to its line of audio gear available in kit and wired form.

The new unit is capable of handling 70 watts continuously, 80 watts momentarily, and 160 watts on intantaneous peaks. Frequency response is 10 to 100,000 cps ±1 db at 1 watt with controlled roll-off above 100,000 cps. Harmonic distortion is less than 2% from 20 to 20,000 cps within 1 db at 70 watts and less than 1% at 60 watts. IM distortion is under 1.5% at



70 watts at 60 and 7000 cps and less than 1% at 60 watts. Hum and noise level is 90 db below full output. Variable damping factor is .5 to 12.

Output impedances of 4, 8, and 16 ohms are provided. A *Chicago* wide-range linear output transformer is used along with a meter for bias adjustment and balance adjust. The amplifier is available in kit form as the KT-400 or fully wired as the LA-70.

Write the company direct for full details and prices.

FLOAT-STROBE UNIT

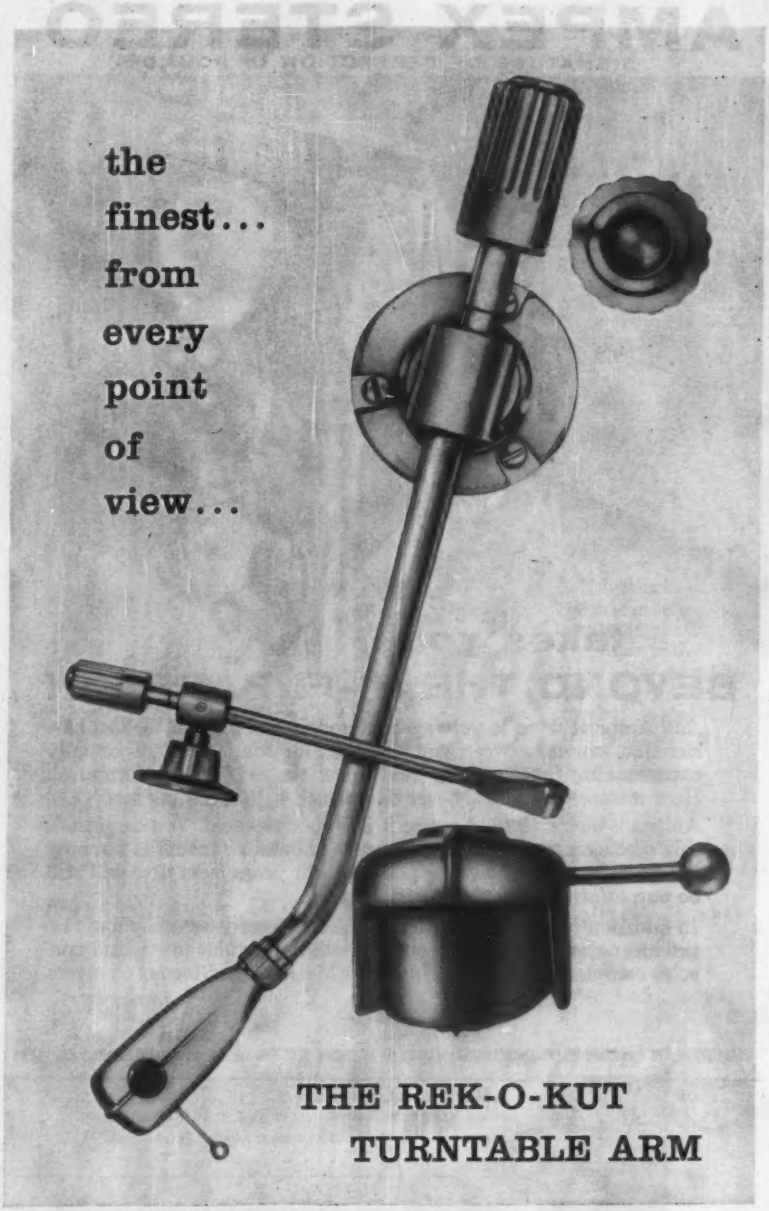
CBC Electronics Co., Inc., 2601 N. Howard St., Philadelphia 33, Pa. has recently introduced a new record float which incorporates a novel strobe design.

Made of aerated polyurethane in assorted decorator colors, the float is useful in protecting valuable records and improving sound quality. Magnetic pull between the cartridge and metal turntable is eliminated and the float helps to absorb motor vibrations.

The label portion is recessed so that records can't slip and a strobe in all three speeds is printed on the label. The unit can be used for promotional purposes as they can be obtained with the dealer's imprint on quantities of a gross or over.

TAPE TENSION GAUGE

American Elite, Inc., 7 Park Ave., New York 16, N. Y. is handling the U. S. distribution of a professional tape tension gauge which is made by *Telefunken* of West Germany.



Most superbly styled of all arms — this is also the *one* turntable arm that offers best compliance, lowest resonance, optimum tracking . . . to give you better sound! That is why it is the *one* arm invariably sold with every turntable — *outselling all other turntable arms combined!* Write for catalog and free Strobe disc. **$26.95** 12" Arm, $29.95 16" Arm.

EXCLUSIVE FEATURES! • Patented sealed Versa-Twin bearing pivot provides superior horizontal compliance. • For free vertical motion, arm pivots are mounted in chrome steel ball-bearing races. • Micrometer gram weight adjustment gives correct stylus pressure without need for stylus gauge. • Has easy arm-height adjustment. Takes all popular cartridges.

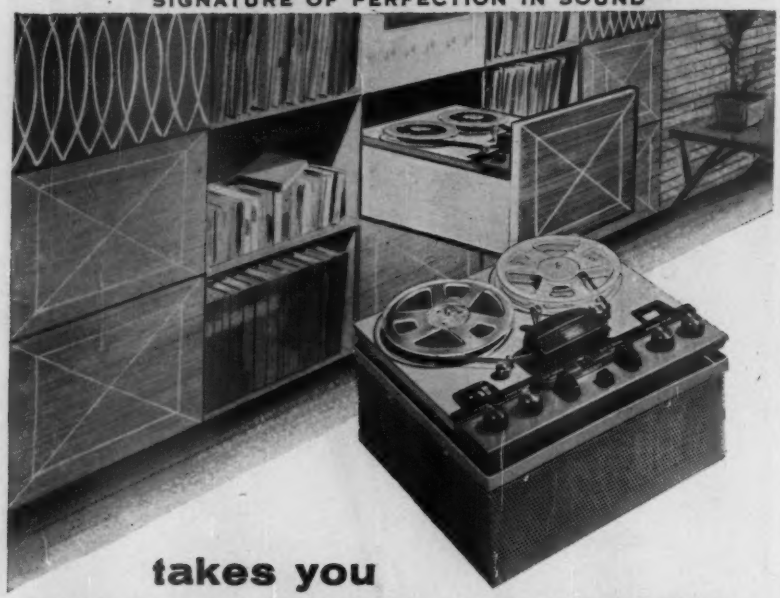
REK-O-KUT

HIGH FIDELITY TURNTABLES–TURNTABLE ARMS

38-19 108th St., Corona 68, N.Y.

AMPEX STEREO

SIGNATURE OF PERFECTION IN SOUND



takes you

BEYOND THE HI-FI BARRIER!

Add Ampex Stereo to *your* system, and you've pierced the last barrier that stands between you and the long-sought goal of actually experiencing the complete realism of the original performance. Hear it once, and you'll never be satisfied with anything less.

Ampex is most-wanted because it is best-engineered. You can install this precision tape-deck in the secure knowledge that it is not only the finest equipment available *today*, but *years from now* will still be outperforming everything in the field.

In addition to the Ampex Model A124-U recorder-stereophonic reproducer shown here, there are portables, modular units, and consoles complete with their own AM-FM tuners and record changers.

AMPEX

CREATORS OF THE VIDEOTAPE TELEVISION RECORDER; MAKERS OF AMERICA'S BEST-ENGINEERED, MOST-WANTED AUDIO EQUIPMENT

AMPEX AUDIO INC.
1044 KIFER ROAD, SUNNYVALE, CALIFORNIA
Please rush free Ampex Stereophonic Sound brochure to:

NAME _____

ADDRESS _____

CITY _____

12 WATT HI-FI AMPLIFIER-PRE-AMP KIT

Simplified step-by-step instruction manual, pictorial and schematic diagrams enable easy construction even without knowledge of electronics.

F. O. B. N. Y. $26.95

SUPER LINEAR WILLIAMSON type amplifier with features found only in expensive units. OUPUT CIRCUIT: 2-6V6/GT. FREQUENCY RESPONSE ± 1 db 15-40,000 cps below 10 watts. SHIPPING WEIGHT 17 lbs. Model FL-10.

Nationally Known Utah Speakers

12" coaxial, exclusive built-in crossover network assures a frequency response from 35 to 17,500 cps. 12 watt cap, 8 OHMS impedance. **$11.95**

Reg. $24.95 .....

NEWEST MODEL MONARCH 4 SPEED CHANGER

4 pole motor, intermix, manual player position, automatic shut-off. British-made. Complete with Ceramic dual sapphire stylli cart. Base for above—$3.50; 45 spindle—$2.39..... **$22.95**

Send for Free Catalogue. Low, Low Prices on All HI-FI Units

CUTICK ELECTRONICS HI-FI RADIO T.V. PARTS
171 Washington St., WOrth 2-5866, New York 7, N.Y.

CONVERT TO COLOR TV

COLORDAPTOR—A simple 10-tube circuit and rotating color wheel converts any-size black-and-white TV, direct view or projection, to receive compatible color TV. **COLORDAPTOR** is simply attached to TV set, does not affect normal operation and can be built from parts experimenters have on hand.

Complete specifications including theory of operation, complete simplified construction plans, schematic and sample color filters **$1.95**

Essential parts kit containing all special parts—coils, delay line, crystal, color filters—

Up to 16" sets— **$19.95** 17" and larger— **$20.95**

All other **COLORDAPTOR** parts, kits, motors, etc. available. Write for information and prices.

COLORDAPTOR, 3471 Ramona, Palo Alto, Calif.

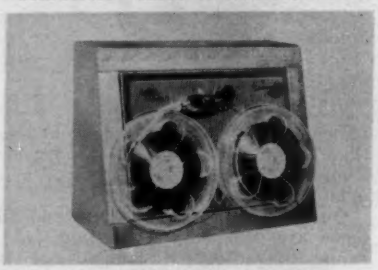
This precision-built unit which is designed to measure the tension of the tapes in tape recorders has all of its movable parts mounted on ball bearings for maximum accuracy. Readings

are taken from the large, clear scale which is marked off in grams.

Write the distributor for full details, price, and delivery data.

VIKING "CONSOLETTE" CASES

Viking of Minneapolis, 9600 Aldrich Ave., South, Minneapolis 20, Minn. has announced the availability of two new "Consolette" cases to house its FF75



series decks and RP61 and RP61S preamplifiers.

The Model 400 accepts any of the company's decks and may be used either vertically or horizontally. It may be combined either vertically or horizontally, with one or more matching 401 amplifier cases to house a complete recorder or stereo combination.

The units are available in neutral tan or black finish.

"WIGO" COAXIAL SPEAKER

United Audio Products, 202-4 East 19th St., New York 3, N. Y. is now

offering a deluxe coaxial speaker, the "Wigo" CX-212B.

Frequency response is 25 to 17,000 cps; nominal power rating is 30 watts; free air cone resonance is 35 cps; and

the flux density is 13,500 gauss.

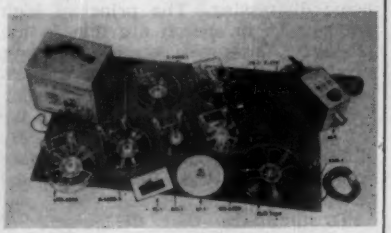
The over-all diameter of the cone is 12" with a front-to-back depth of 7½". There is a 1½" voice coil on the basic speaker and ½" voice coils on the tweeters. A baffle opening of 10½" is required.

The speaker has a heavy cast aluminum frame upon which the tweeters are mounted at an angle to provide 120 degree sound dispersion. A climate-proof synthetic is used for the voice coil and cone suspension.

A data sheet on the CX-212B is available from the manufacturer on request.

PENTRON UNIT ACCESSORIES

The Special Products Division, *The Pentron Corporation,* 777 S. Tripp Ave., Chicago 24, Ill. has announced



a complete line of accessories designed to be used with its "LP Magazine Repeater," an endless tape unit for demonstrating products, playback of sales messages, etc.

The unit plays from 1 minute up to 55 minutes. The new accessories include remote operating equipment, extra magazines, recorded music, patch cords, loading plates, tape splicing kits, etc.

For a multi-colored brochure on the repeater and its accessories, write the manufacturer direct.

AUDIO CATALOGUES

CHOOSING A TAPE

Reeves Soundcraft Corp., 10 E. 52nd St., New York, N. Y. has prepared a colorful pamphlet of interest to home recordists entitled "How to Choose the Right Recording Tape."

The publication offers general information on magnetic recording tape, recording characteristics, and the elements, such as *Mylar* and cellulose acetate, which govern the physical characteristics of the product. Specifications on the firm's *"Soundcraft"* tapes are included.

The booklet also describes the individual requirements which should be considered in the choice of tape, including permanence, recording times, dimensional stability, and price.

BAFFLE CATALOGUE

J. J. Powers Company, 1317 S. 5th Ave., Maywood, Ill. has issued an 8-page catalogue which describes its complete line of loudspeaker baffles.

Included are wall and ceiling styles in hardwood, hardboard, and metal as well as portable models, high-fidelity enclosures, and accessories. Specifications needed by contractors, architects, and sound engineers are given. —30—

Custom-crafted motors feature wear-resistant bearings, electronically-balanced rotors.

Motor pulley machined with motor in operation—insures permanently smooth power transmission.

Special neoprene tire on idler wheel provides rumble-free traction and durability.

Motors and drives checked under operating conditions—insuring lifelong unerring performance.

Self-lubricating Spiral-Grooved turntable shaft, exclusive with Rek-O-Kut, provides oil-cushioned spin on chrome-steel ball bearing.

Cast aluminum turntable with resonant-inhibiting properties... machined to aircraft tolerances.

Prices from $59.95

Write for Catalog and FREE STROBE DISC

REK-O-KUT HIGH-FIDELITY TURNTABLES—TURNTABLE ARMS

Dept. 123 38-19 108th ST., CORONA 68, N. Y.

This CHANGER tops wow and flutter standards for broadcast turntables

Thorens CD-43 record changer

"Under almost all conditions the unit was better than the NARTB specification for broadcast reproducing turntables."

That's what C. J. LeBel of the Audio Instrument Company, an independent testing lab, says about wow and flutter in the Thorens CD-43 record changer.

Mr. LeBel tested three sample changers picked at random from our warehouse stock. Here are the actual test figures for the *worst* of these three units:

Serial No.	Line Voltage	Speed RPM	No. Discs on turntable	Wow + Flutter (%) RMS	Peak
71185	120	33⅓	1	0.2	0.25
			10	0.15	0.20
		78	1	0.06	0.1
			10	0.04	0.08
		45	1	0.1	0.15

Note that only one measurement lies slightly outside the NARTB standards limit of 0.2% peak wow. All other measurements on this changer were within NARTB peak limits. Note too that *all* the RMS measurements (prescribed by American Standards Association and believed to be a more accurate index to subjective effect) are well below this value. And, of course, these outstanding results apply also to the Thorens manual player, audiomatic player, and transcription turntable since they all use the same precision motor.

Now all Thorens units are covered by a 1-year guarantee. This new guarantee plus tests like the above are your insurance that you are getting the best record changer money can buy when you select a Thorens—whether it's for yourself or for your customers. See the Thorens CD-43 at your dealer's today. 7.7

FREE! Send for booklet "Hi-Fi and Your Budget" to Thorens Company, Dept. R10-7, New Hyde Park, N. Y. Don't forget to include *your* name and address.

THORENS SWISS MADE PRODUCTS

MUSIC BOXES • HI-FI COMPONENTS • SPRING-POWERED SHAVERS • LIGHTERS

Choosing Crossovers

(*Continued from page 54*)

be illustrated by showing what results without it. If a loudspeaker consists of two units, say one handling below 600 cycles and the other above, and the low-frequency unit gives a good smooth response radiated uniformly into the room, while the high-frequency unit tends to eject its frequencies in a concentrated beam, away from the low-frequency unit, one can easily get the impression that the high frequencies in the audio spectrum are "squirted in" as an afterthought from the side.

This is quite unrealistic on musical reproduction, and on speech it can become distressing. The principal high frequencies in speech are due to the sibilants, "s's" and so on. Lack of good integration will give the impression that most parts of the voice come from the low-frequency unit, while the "s's" are added from some completely different direction. This is even more unnatural than the effect on musical programs.

To summarize, then, the question of choosing a loudspeaker system and what crossovers to utilize in it, depends to a considerable extent upon the rest of your system.

If you have a larger-than-average living room to supply with sound, or if you intend to operate at unusually high levels, with an amplifier of 50 watts or more, then intermodulation is likely to trouble you, and a three- or four-way crossover is advisable.

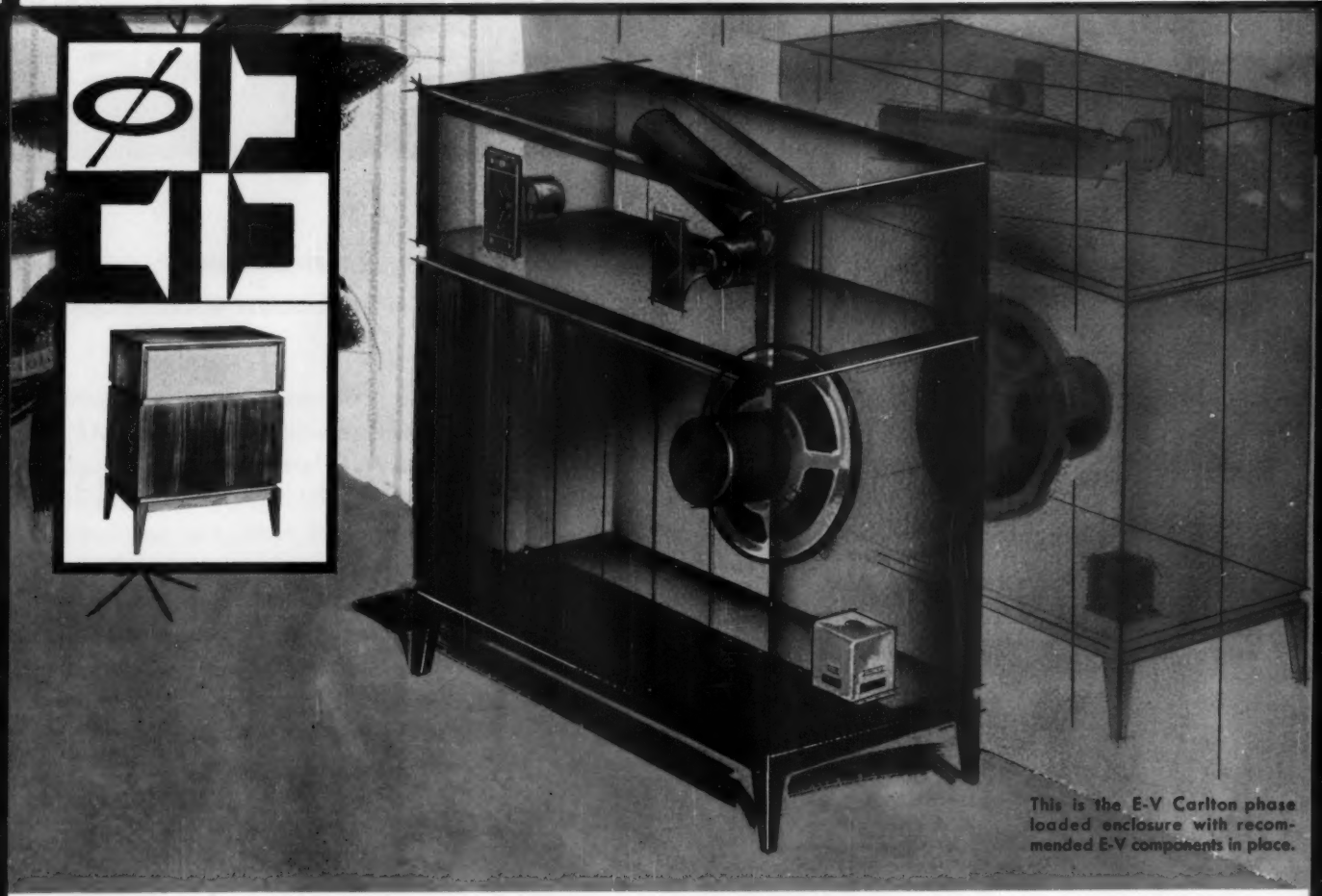
For more average sized living rooms and moderate levels of reproduction, a three-way crossover will certainly be adequate, and for smaller systems a two-way crossover is quite sufficient.

The best choice of crossover frequency(ies) and the sharpness of the crossover is dependent upon the types of units used. While there are broad principles, based on the frequency spectrum itself, these are modified to a considerable extent by the effectiveness of the units. In most instances, combinations put out by a single manufacturer usually incorporate the best crossover frequency for that combination.

While sharper crossovers have certain advantages in some circumstances, it is better all round to choose a crossover with a more gradual transition from one unit to the other as frequency passes through this region.

Fortunately in this branch of high fidelity we find the same thing we find elsewhere, that paying a lot more for a more complicated system does not *necessarily* give us better performance. In fact, if you shop around, you will be able to find quite a good performing system at whatever price you are prepared to pay. By paying more you naturally *can* get a better system, but just paying more and getting more equipment into the system doesn't mean it must be a better one. —30—

DESIGNS FOR



This is the E-V Carlton phase loaded enclosure with recommended E-V components in place.

Electro-Voice® MAKES HI-FI HISTORY WITH EXCITING NEW PHASE LOADED ENCLOSURES

For the first time—and only from Electro-Voice—you get performance from along-the-wall speaker enclosures which approaches the performance of a corner horn! E-V does it with the exciting new principle of PHASE LOADING, the most important advance in baffle design since the Folded Corner Horn!

Designed specifically for use along a wall, phase loaded cabinets give you almost a full added octave of bass range and completely eliminate the "boomy" characteristic of bass reflex enclosures.

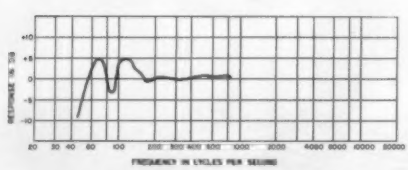
Flat, fundamental response is obtained *two* ways with *PHASE LOADING:*

First, by placing the driver at the rear of the cabinet close to the floor, and facing the wall. The wall and floor act as reflecting surfaces, close and almost equidistant from the driver cone, eliminating phase difference between reflections and the source.

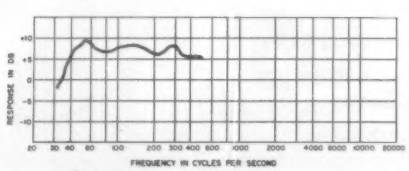
Secondly, *Phase Loading* permits a sealed cavity behind the cone, of precise volume. The compliance of this cavity, in conjunction with the mass of the cone, is made to react with the mass and compliance of the outside air throughout the second octave, adding this range to the response not otherwise attainable except through corner horns.

The low crossover of 300 cps makes this system possible, for higher frequencies are not propagated properly by indirect bass radiators.

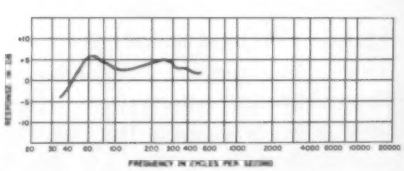
The application of these principles in E-V's PHASE LOADING gives full-bodied, extended low-bass hitherto unavailable. Musical balance is achieved for the first time in an along-the-wall system.



This curve shows performance of the usual 4-way systems in a bass reflex cabinet. Note the dip at 85 cps, which shows the destructive cancellation and the reinforcement (peak) at 120 cps which causes "boom."



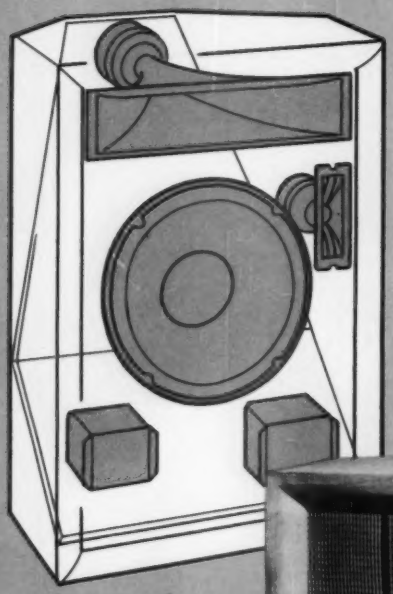
This curve shows the smoothness throughout, the extra response and the extended bass response you get *only from* a folded horn corner enclosure.



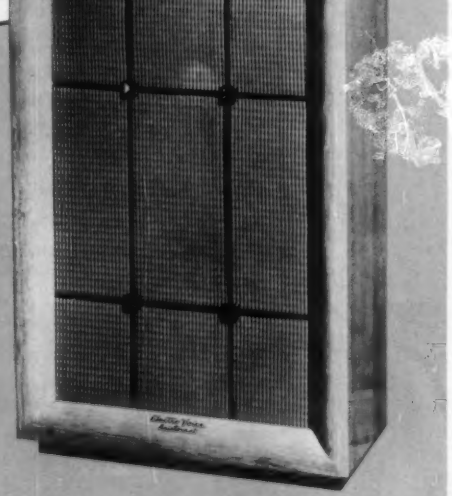
This is E-V phase loading. As you can see, performance in an along-the-wall position closely approaches that of the corner horn.

FOLDED HORNS

DESIGNS FOR



The speaker system shown mounted in place is one of more than a dozen variations which may be employed in the ARISTOCRAT enclosure alone. Speaker performance data below.

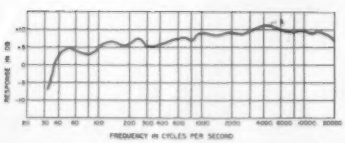


ARISTOCRAT 1A

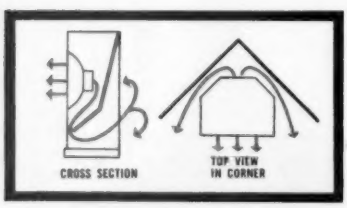
Mahogany	$240
Blonde	247
Walnut	247

THE DIRECT RADIATOR CORNER HORN

Typical of Electro-Voice direct radiator folded horn corner enclosures is the ARISTOCRAT, a deluxe space-saver designed for use with E-V 12-inch coaxial speakers, TRX integrated three-way speakers or your choice of speaker systems. It is designed for use in a corner, where the walls of your room serve as extensions of the bass horn to deliver one full extra octave of bass range. Increased power-handling in the lower range is as much as 50%.



This E-V ARISTOCRAT, like the full line of Electro-Voice corner enclosures, makes use of room walls and corner to propagate lowest bass tones. Curve shows smooth, flat response.

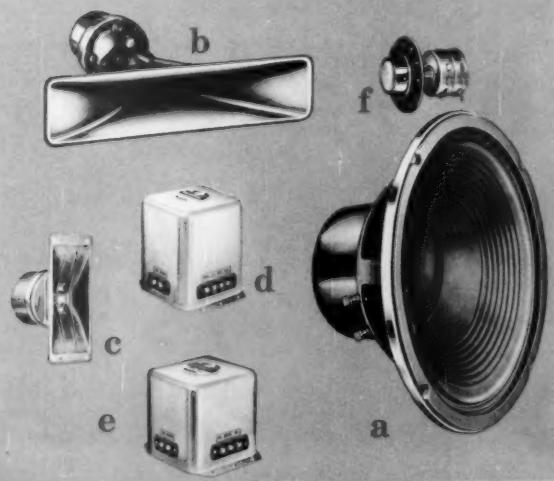


The folded corner horn drawings here show the sound path from direct radiators.

Integrated Speaker Systems

This is the Electro-Voice 108A *direct radiator* speaker system shown in the ARISTOCRAT enclosure above. It's an economy 3-way system employing (**a**) 12BW low-frequency bass driver; (**b**) T10A treble driver with 8HD horn for mid-range reproduction; (**c**) T35B very-high-frequency driver for silky highs; (**d**) X825 crossover; (**e**) X36 crossover; (**f**) two AT37 level controls plus wiring harness and baffle board. Crossovers are at 800 cps and 3500 cps, lowering intermodulation distortion and assuring optimum operation of each element in the system. Complete, ready to install, Net $168.

INTEGRATED



FOR HI-FI ON A BUDGET, FOLLOW THE

which shows the destructive cancellation and the reinforcement (peak) at 120 cps which causes "boom."

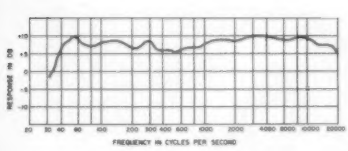
only from a folded horn corner enclosure.

of the corner horn.

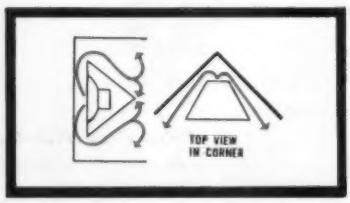
FOLDED HORNS

THE INDIRECT RADIATOR CORNER HORN

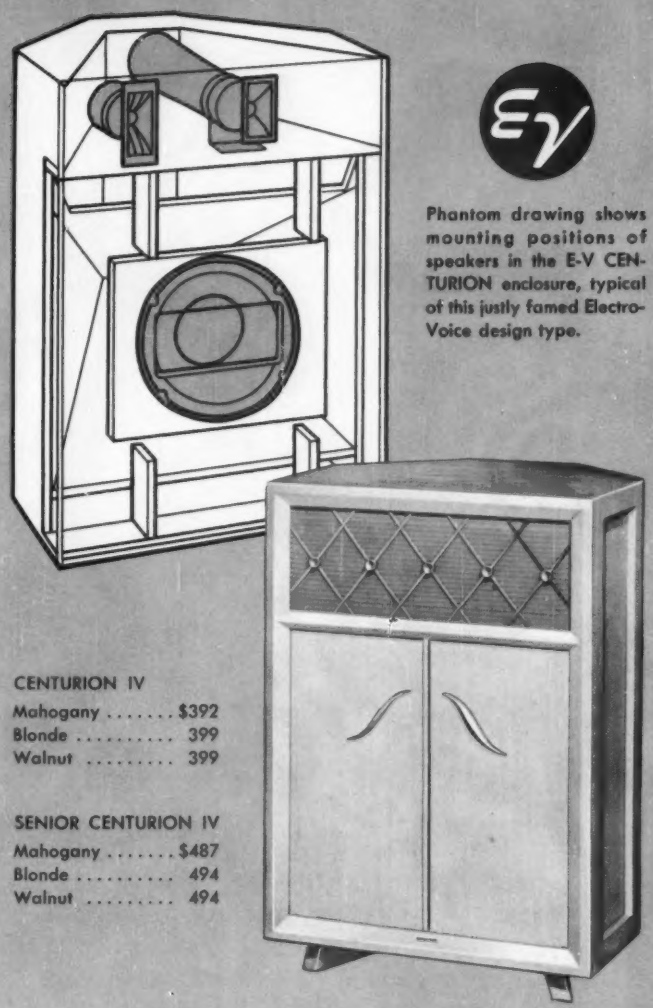
Using an advanced indirect horn-radiator principle E-V design extends the lows, enhances highs, uses room walls as extensions of the exponential horn air load. Indirect radiation and employment of low crossover frequency, allows exploitation of the sealed cavity feature explained on Page 1. These enclosures actually assure more than one full octave of added bass with unprecedented efficiency, provide direct front radiation of higher frequencies, cleaner overall musical balance.



This is the response curve of an Electro-Voice Centurion indirect radiator folded corner horn enclosure employing a 4-way speaker system. Note the essential flatness of response.



Arrows in diagram show sound path in an indirect radiator corner enclosure.



Phantom drawing shows mounting positions of speakers in the E-V CENTURION enclosure, typical of this justly famed Electro-Voice design type.

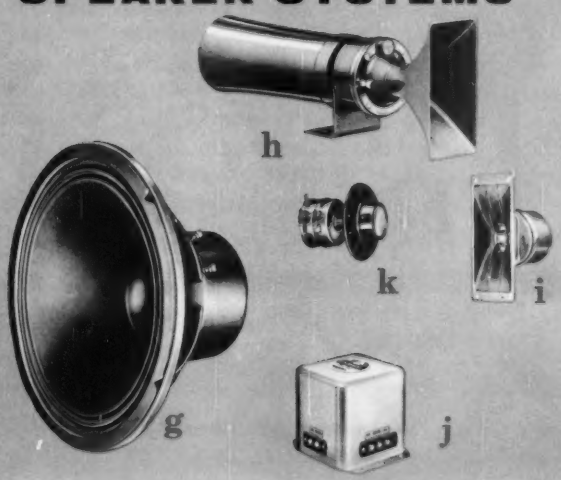
CENTURION IV

Mahogany	$392
Blonde	399
Walnut	399

SENIOR CENTURION IV

Mahogany	$487
Blonde	494
Walnut	494

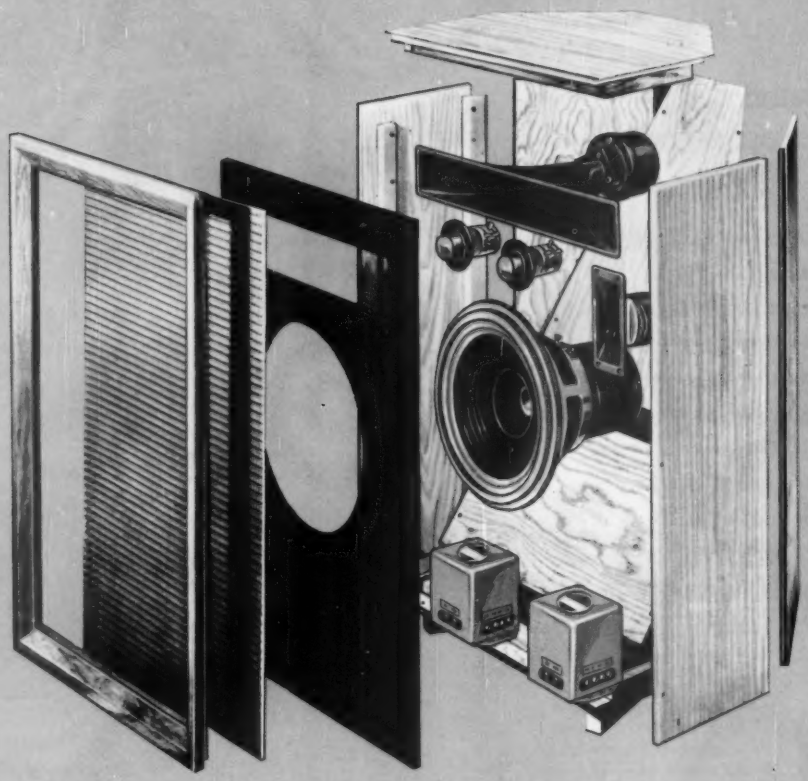
SPEAKER SYSTEMS



This is the 117B indirect radiator speaker system shown in the CENTURION enclosure above. It is an economy 4-way system of unusual performance and high value (**g**) 15BWK "K" type low-frequency driver for bass reproduction; (**h**) MT30B coaxial mid-bass and treble driver-horn assembly; (**i**) T35B very-high-frequency driver for smooth reproduction of the highs; (**j**) X36 crossover; (**k**) two AT37 level controls plus wiring harness and complete instructions including enclosure construction details. Electronic crossovers are at 300 and 3500 cps and there is an acoustic crossover at 1000 cps. Complete, Net $151.

Also shown are some of the components included in the deluxe 105E system of the same type. This deluxe system substitutes a high-efficiency 15WK LF driver for the 15BWK bass reproducer shown and also includes MT30 mid-bass horn assembly and a new T350 VHF driver, an Ultra-Sonax model which has a frequency response of 2kc to 21 kc, ±2db. The deluxe 105E system complete, Net $245.

FOR HI-FI ON A BUDGET, FOLLOW THE ELECTRO-VOICE BUILDING BLOCK PLAN



Start with your basic speaker and improve your compatible E-V high-fidelity system one economical step at a time by adding Electro-Voice Speaker Building Blocks.

Here, we've started with an SP12—12-inch coaxial driver. Later, you add BB2—a T35 very-high-frequency driver, X36 crossover and AT37 level control with wiring harness. BB2, Net $50. Still later, augment with the BB4—to smooth and disperse treble range, it includes T25A treble driver, with 8HD horn, a second crossover—800-cps X8—and a second AT37 level control with wiring harness. BB4, Net $114.

Build Your Own E-V Speaker Enclosure with a Pre-Cut, Pre-Cleated *'Do-It-Yourself'* Kit

There's no thrill like building your own speaker enclosure! Economize on your hi-fi system without sacrificing quality by assembling an E-V knock down kit of Korina plywood. Korina is of highest quality, naturally light in color, harder than mahogany, allows finishing to match any shade. There are seven models to choose from.

Shown dis-assembled is E-V's KD6 kit. Assemble it and you have a duplicate of our factory-built ARISTOCRAT enclosure of folded horn corner design for use with 12-inch drivers or separate multi-way systems. KD6, Net $39.

Printed in U.S.A.

For all the facts about Electro-Voice 'Listeneered' high-fidelity components, see your distributor and write for complete details.

Electro-Voice®

ELECTRO-VOICE, INC. BUCHANAN, MICHIGAN

Export: 13 East 40th Street, New York 16, U.S.A. Cables: ARLAB

21 kc, ±2db. The deluxe 105E system complete, Net $245.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					4	5
					12	
					19	
					26	

CALENDAR of EVENTS

SEPTEMBER 30
Lecture Series on Transistor Theory and Applications. Sponsored by Chicago Section of IRE. Goodman Memorial Theatre, 300 E. Monroe St., Chicago. Eight 2-hour lectures on consecutive Monday evenings. Registration fee $6.00 for members and students, $9.00 for non-members. Contact Stuart McCarrell, 2900 W. 36th St., Chicago 32, for further information.

OCTOBER 7, 8, 9
National Electronics Conference. Sponsored by A.I.E.E., IRE, Illinois Institute of Technology, University of Illinois, and Northwestern University. Hotel Sherman, Chicago, Ill. Inquiries should be addressed to NEC, 84 E. Randolph St., Chicago 1, Ill.

OCTOBER 7-12
New York High Fidelity Show. Sponsored by the Institute of High Fidelity Manufacturers. New York Trade Show Building, New York City. Contact Institute at 125 E. 23rd St., New York 10, N. Y.

OCTOBER 8-12
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All About Audio
(Continued from page 65)

resonator, but the worst loudspeaker I ever heard was the result of fixing a moving-coil driver to a point on the soundboard of a piano. (It is impossible to make speakers for 25 years without trying a few silly ideas.)

The main resonances in a moving-coil unit are due to (*a*) fundamental cone resonance; (*b*) cone break up; (*c*) surround resonance; and (*d*) resonance of spider or centering device. In so far as the electrostatic speaker avoids these pitfalls it can be said to have a better transient response, but it must not be assumed that moving-coil design remains stagnant. The main cone resonance is virtually damped out by the modern amplifier and by high flux density in the magnet. The effects of cone break up can be side-stepped by the use of dividing networks, by soft cone texture in large speakers, and stiffer diaphragms in small units. Surround resonance is avoided by using soft cloth or foam plastic surrounds or by completely free suspension. The centering device is still a necessary evil with moving-coils, but its resonance is the least objectionable of those cited. In small units limited to frequencies above 1000 cycles, the conventional spider or corrugated disc can be dispensed with and the coil can be held in center with a simple cloth disc which is entirely resonance-free. (We adopted this arrangement on a 3" unit several years ago with complete success.)

There can be little doubt that a really perfect loudspeaker would be massless. The "Ionophone," as it is known in England, seems to be the nearest approach to date, but its development has been bedevilled by distortion troubles and all the old problems of horn loading, plus radiation which interferes with TV reception within a small area, probably not exceeding a radius of 50 feet.

The diaphragm in a moving-coil speaker is receiving shock after shock and it is this state of affairs which colors the reproduction. Pictures of the effect of shock treatment are therefore not without interest, and a few are reproduced in Fig. 26. The voice coil is held off its central position by applying a suitable value of direct current. When the circuit is interrupted the voice coil moves and the e.m.f. generated in it as the vibrating coil cuts the magnetic field operates the oscilloscope by the triggered time base, the result being photographed.

In all cases shown in Fig. 26, wider spacing between vibration peaks indicates a lower resonance frequency of the cone. The benefits of high flux density, non-resonant surrounds, and free suspension with low cone resonance are clearly shown. The cone assembly in examples *A* and *D* is obviously behaving like a drum and is

typical of the cheap, mass-produced speaker.

The tests just described were made about five years ago. This (or any other) method of photographing what takes place always appeals to me strongly because the results are theory-free and enduring. Given an accurate statement of conditions of test and a carefully considered interpretation, the findings will be as true in a hundred, or even a thousand, years as they are today.

Quite recent tests on 10" units are shown in Figs. 27 and 28 and again confirm the virtues of soft surround and high flux density.

The results shown in Fig. 28 speak for themselves.

It will be seen from Fig. 27 that with the same input voltage and identical cone and coil assembly the deflection of the voice coil is almost three times as great with the higher magnetic flux, but the coil comes to rest with half the number of oscillations. Translated into speaker performance, this means much higher sensitivity (or fewer watts from the amplifier!) plus cleaner reproduction and superior transient response. In fact, the virtues of high flux density—or in other words expensive magnets—are beyond dispute and are confirmed by the most primitive listening test. (*Continued in Dec. Issue*)

Substitution Jigs

(*Continued from page 49*)

soldering individual resistors in place each time.

The block-like device in Fig. 3 is a pair of silicon rectifiers (*Sarkes Tarzian* M-500) in a standard holder. This unit can be used as a single half-wave rectifier, a high-voltage half-wave rectifier (two rectifiers in series, useful up to 260 volts), or as a two-section rectifier in a voltage doubler. It can be used for temporary substitution in new sets using silicon rectifiers or in older sets that originally used selenium rectifiers, whenever it becomes necessary, in receivers of this type, to make checks on the operation of the power supply.

Fig. 4 shows a detector circuit for obtaining an audio signal from a signal generator that does not have an audio output jack. Only two parts are used: a 1N34 crystal diode and a 470,000-ohm resistor. The unit is constructed just like the twin-resistor jig shown in Fig. 2. Connect the signal-generator output to the input of the detector, set the signal generator to any convenient frequency, and the audio signal will appear across the 470,000-ohm resistor. This audio signal can then be fed to the circuit under test. Its strength can be adjusted with the r.f. attenuator on the signal generator.

A similar unit using a 1N82 high-frequency diode and a 4700-ohm resistor is handy for checking the output

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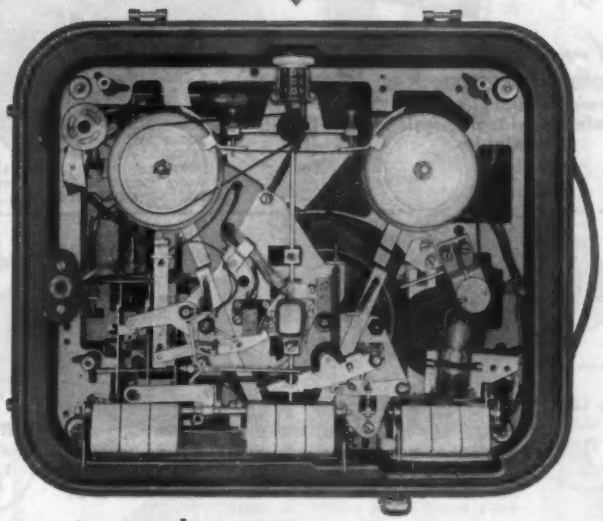

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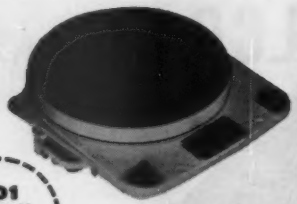

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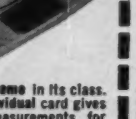

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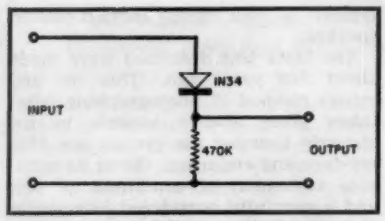


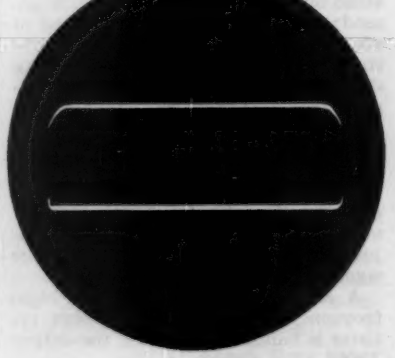
Fig. 4. This detector jig provides an audio signal from a modulated generator which does not have a separate audio jack.

of a sweep generator to be sure that it is reasonably constant over a particular range. If the sweep generator does not have a terminating resistor at the output of its cable, connect one having a resistance value equal to the characteristic impedance of the output cable. This will prevent standing waves from appearing because of possible impedance mismatching. Connect the sweep-generator output to the detector input, and connect the scope input to the detector output of the generator.

If the sweep-generator output is constant over the particular range, the trace on the scope will be similar to that shown in Fig. 5. Any humps or dips in the trace indicate that the sweep generator output is not constant over the range. (Incidentally, it is well to check the detector on various ranges first with a sweep generator known to have constant output. This is to prevent possible resonance effects in the detector circuit from giving misleading results. This is particularly important on the higher TV channels.)

The jigs described here are those the author has found most useful. Other service technicians may think up their own to fit particular problems that come up again and again. Technicians doing warranty work on a specific line of equipment will probably find special units with parts that frequently fail very useful. Almost any part can be put in a jig like this. Perhaps the only exceptions are parts used in high-frequency circuits. For example, substitution of a new diode in a u.h.f. converter circuit cannot be done this way. You still have to clip the leads and solder the part in place. —30—

Fig. 5. Trace of flat band of a sweep generator, taken through detector probe.



Certified Record Revue

(*Continued from page* 50)

of them are howlingly funny, as he makes allusions to Brahms, Dukas, and Richard Strauss. Victor Aller affords a most sympathetic performance of the "Variations" and in general takes a broader more understanding viewpoint of the work than did Katchen in the *London* recording.

Again the sound is outstanding, with a piano that is flawlessly reproduced with never a quiver of wow or flutter. Dynamic range in both scores is impressively wide and *Capitol* has reached a new high in frequency range and lack of transient distortion. If *Capitol* didn't record this in stereo, they should be taken out and shot! If this record doesn't impress you on really good first class equipment, you just don't like hi-fi!

SIBELIUS
TONE POEMS
Philharmonic Promenade Orchestra of London conducted by Sir Adrian Boult. Vanguard VRS 489/90. RIAA curve. Price $9.96. Two discs.

I listened to this recording one night when I wasn't feeling very well and I was prepared to be most nasty and vituperative if I detected even the slightest "flurp." After three minutes of the opening tone poem "En Saga," I was glassy-eyed and I remained so for the duration of the recording. The only thing I can say is that this is absolutely marvelous. Sir Adrian wove such a magical spell, Sibelius was such a fount of inspiration, and the sound of the orchestra so overwhelmingly alive and natural that I quite forgot my bodily ills and was thereafter speechless in admiration.

This is surely one of *Vanguard's* supreme achievements in recorded sound. Combine the most silken of string tone with brass which can be huge and brazen or bright and punchy, woodwind of unsurpassed beauty of intonation, especially the lower register stuff in the bassoon and contrabassoon, clarinet and English horn. Add percussion ranging from the scintillant smash of cymbal to the weighty impact of tympani and the tremendous whump of bass drum. These *Vanguard* bass drums must be something special . . . the power they generate is tremendous, and they are way, way down in the low frequencies. It takes a really big, top-quality speaker to reproduce some of these drum beats. The thing that really is impressive is that there are bass drum accents throughout these tone poems, that are quite low on the dynamic scale and yet with the proper equipment they can be heard and they lend an infinite amount of realism to the score in general.

The over-all presence in this recording was quite astounding and made one forget that a mechanical medium was involved. Heard on these two discs are "En Saga," "The Swan of Tuonela," "Lemminkainen's Homecoming," "The Bard," "Pohjola's Daughter," "Finlandia," "Prelude to the Tempest," "Nightride and Sunrise," "Oceanides," and "Tapiola." If you love Sibelius this is an absolute and unqualified "must."

ORFF, CARL
CARMINA BURANA
Agnes Giebel, soprano; Marcel Cordes, baritone; Paul Kuen, tenor; Chorus of West German Radio. Cologne Radio Symphony Orchestra conducted by Wolfgang Sawallisch. Angel 35415. RIAA curve. Price $3.98 (standard package).

Carl Orff is probably the most controversial of contemporary German composers. He has gained considerable notoriety in this country with such works as "Carmina Ca-

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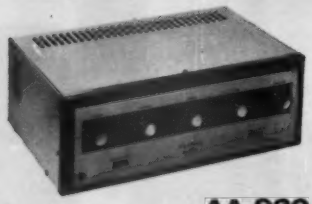

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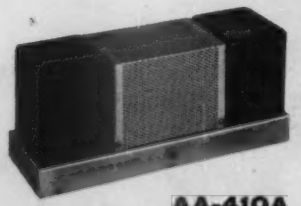

AA-410A

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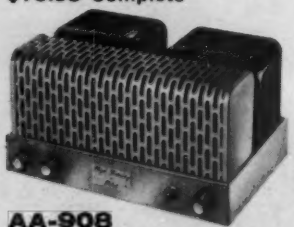

AA-908

Basic amplifier—rated output with less than 1% distortion: 40 watts (80 watts peak); frequency response: 20 to 20,000 cycles, ±0.1db; 6CA7 output tubes; provision for selecting optimum damping factor. Chassis and cover cage finished in brushed brass.

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tulli" in which the text employed is from some very racy Roman poetry, the equally eyebrow-raising "Trionfo di Afrodite," and this group of secular songs called the "Carmina Burana." The songs were written in medieval Latin and German by vagrant scholars, vagabond poets, and wandering monks of the 13th century. The manuscripts were discovered in the Monastery of Benediktbeuern, south of Munich, and "Carmina Burana" means literally . . . "Songs of Beuren."

Orff's musical language is like nothing else you've ever heard. Using the Latin text, he uses infinite repetition on a rhythmic basis, with changes in meter and dynamics. Some variations are extremely subtle, some are blunt, almost shocking. A huge orchestra is employed, with greatly augmented percussion and two pianos. The result is some of the most fantastic music and sound in the entire recorded repertoire. You don't have to be musically erudite to enjoy this score. Honestly, on the basis of sound alone this is vastly entertaining. This recording was supervised by Orff himself and unless I miss my guess, it is he who is responsible for the marvelous work of the chorus. In the incredibly complex phrasing of the text this chorus is astounding. Their articulation is ultra-precise, their rapid and accurate changes of rhythm and meter, their strict adherence to a set tempo is nothing short of a wonder.

High and low percussion is employed lavishly throughout the score and is superbly clean and crisp. Orff has a way of using his two pianos percussively in the very lowest registers that adds an exciting solidity to the orchestral. The soloists are superb, with a special nod to Marcel Cordes who much of the time is using the very highest range of his magnificent baritone. You should be very careful in setting your volume control in listening to this recording. The dynamic range is extreme and with Orff's sudden changes of mood, what seemed like a reasonable level is all at once blasting you out of your seat. The over-all recorded sound is clean and sumptuous, all elements beautifully balanced with no choral/orchestral "blur" and the acoustics afford a fine roundness and "liveness," while preserving detail. An unusual musical experience awaits those of an inquiring mind. Certainly this is one of *Angel's* most outstanding recordings.

SCHUBERT
SYMPHONY #4 ("TRAGIC")
SYMPHONY #5
Philharmonic Symphony Orchestra of London conducted by Dean Dixon. Westminster XWN18485. RIAA curve. Price $3.98.

Schubert's 4th symphony occupies an odd place in the recorded Schubert repertoire. It has received relatively minor attention, and no conductor who is supposed to be noted as a "Schubert specialist" has ever made a recording of the score. The 5th symphony on the other hand, has been recorded on LP nine times by such stalwarts as Walter, Toscanini, and Karl Bohm. Thus Dixon is up against stiff competition in the 5th symphony but has the field almost to himself in the 4th symphony. Dixon is a fine mature conductor who has built up quite a reputation in Europe. He is especially noted for his readings of Vivaldi and Corelli and other baroque composers. His approach to these works is quite straightforward. He keeps tight rein on his orchestra with a firm sure beat, he displays little in the way of conductorial idiosyncrasies and, in general, affords us readings of these works which, if not of the calibre of definitive, are at the very least completely honest and always musicianly. Above all, with the superior recorded sound Dixon gets from the *Westminster* engineers, these works

country with such works as "Carmina Ca-

are a joy to hear. This is a hugely resonant sound, with reverberation time judiciously balanced against orchestral detail. The strings were smooth and free from "wiriness," yet they had a fine incisive "bite" on attacks. Woodwinds were well forward, nicely balanced and blended, with every voice completely articulate; brass was bright and clean with a lovely rounded sound from the horns and trumpets. No percussion is employed in the 5th symphony, but the tympani in the "Tragic" were crisply defined and notably accurate. Frequency range was pleasingly wide and dynamic range was more than adequate to the demands of the scores. All in all, this is the big open type of recording that has a great deal of presence and compelling realism.

TCHAIKOVSKY
PIANO CONCERTO #2 IN G MAJOR

Shura Cherkassky, pianist, with Berlin Philharmonic Orchestra conducted by Richard Krauss, Decca DL9916. RIAA curve. Price $3.98.

Tchaikovsky did indeed write a second concerto which has unjustly been in the shadow of the famed "B Flat Minor" concerto for too many years. This has most of the elements which contributed to the popularity of the 1st concerto. It is melodious, bright and bouncy, is full of bravura piano gymnastics to test the mettle of any virtuoso, and the orchestration is typically Tchaikovskian and exciting.

Cherkassky has made a specialty of this work and his reading is quite unexceptionable. With admirable support from Krauss and the Berlin Philharmonic, and with bright clean piano sound, fine orchestral sound somewhat closer recorded than is usual for *Decca* with wide frequency and dynamic range, this is the recording of choice among the six recorded versions in the LP catalogue.

Pop Corner

FRED WARING AND THE PENNSYLVANIANS IN HI-FI

Capitol W845. RIAA curve. Price $3.98.

Fred Waring has been recording for a good many years now and if you like his music, you've undoubtedly acquired a number of his discs. Quite possibly many of the numbers on this disc duplicate what you already have, but I'll guarantee that you've never heard Fred Waring sound as he does on this recording! This is one of the best examples of what top quality hi-fi recording can accomplish. The famous Waring choir is full and rich, with smoothly homogenous tonal balance. Yet every voice is articulate, the diction clean and crisp. There is no choral/orchestral "blur" or fusion. The orchestral elements complement the chorus in perfect balance. Here is bright punchy brass, the rich sonority of the saxes, the crisp cleanness of the strings as they pour out the familiar melodies. Heard in this lovely panoply of sound are such favorites as "I Hear Music," "Dry Bones," "Ol' Man River," "The Whiffenpoof Song," "Sometimes I Feel Like a Motherless Child," and others including a tremendously exciting version of the "Battle Hymn of the Republic." This was recorded stereophonically and is now available on the new *Capitol* recorded tapes. This is superb as a disc . . . as a stereo tape I am drooling in anticipation!

That more or less cleans up the backlog of the many fine recordings that have been pouring off the presses at an accelerated pace. The demand seems to be insatiable but the disc outfits are doing their best.

Next month, I hope I can bring you a magnum-sized column with many, many reviews. See you then. —30—

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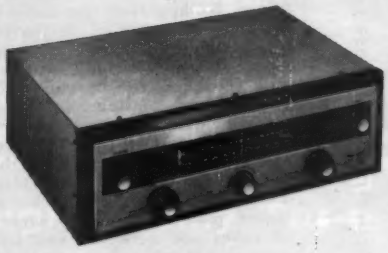

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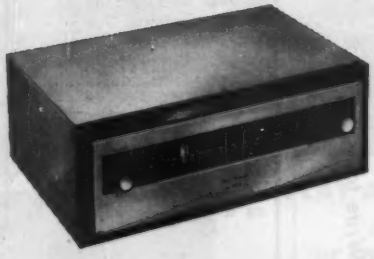

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Improving The Cross-Coupled Inverter

By NICHOLAS PRYOR

A simplified version of the Van Scoyoc circuit of 1948.

IN THESE days of extreme amplifier bandwidth, a phase inverter with good balance and low reactive phase shift over a wide frequency range becomes a necessary part of any amplifier design. The circuit that most nearly meets these requirements is the cross-coupled inverter developed in 1948.

Phase shift is held to a minimum by the small number of phase shift points within the inverter. The low output impedance of the first stage minimizes high-frequency shift and direct coupling eliminates it at the low end. The only point of low-frequency shift is in the output capacitors and the following grid resistor; the bulk of the high-end shift is also due to the 30,000 ohm output impedance of this stage.

Theoretically perfect balance is obtained by applying the same signal to different elements of the inverting triodes as shown in Fig. 2. Other circuits either depend on inherent imbalance and feedback for operation (cathode-coupled and floating paraphase) or require precision components for approximate balance (split load and voltage dividing). Another feature of this circuit is constant balance at all frequencies. This is true because both halves of the signal pass through the same number of tubes and networks and both signal outputs are taken from similar elements of the output tubes (as opposed to the split load).

There are, however, some incorrect notions about the balancing in the cross-coupled inverter. First, with a single-ended input, the balancing control between the cathodes of the first stage does not balance the dynamic characteristics of the amplifier. It merely balances the tube bias and equalizes the sensitivity of the two inputs. Since neither of these is very critical in the improved model of the inverter, this control can be omitted as it was in the original Van Scoyoc circuit. Provision for dynamic balance is included elsewhere in the new circuit.

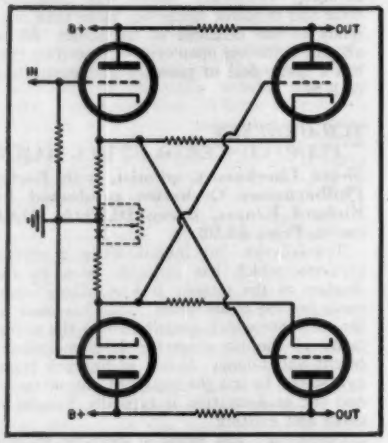

Fig. 1. Original cross-coupled inverter as described by Van Scoyoc in 1948. Balance control, added later, is shown dashed.

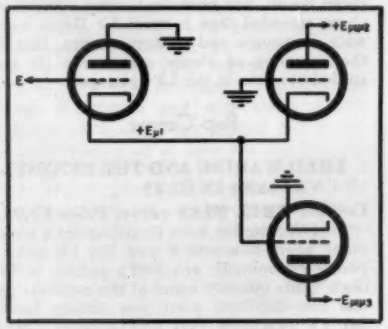

Fig. 2. Simplified inverter circuit showing just a.c. paths, in interest of clarity.

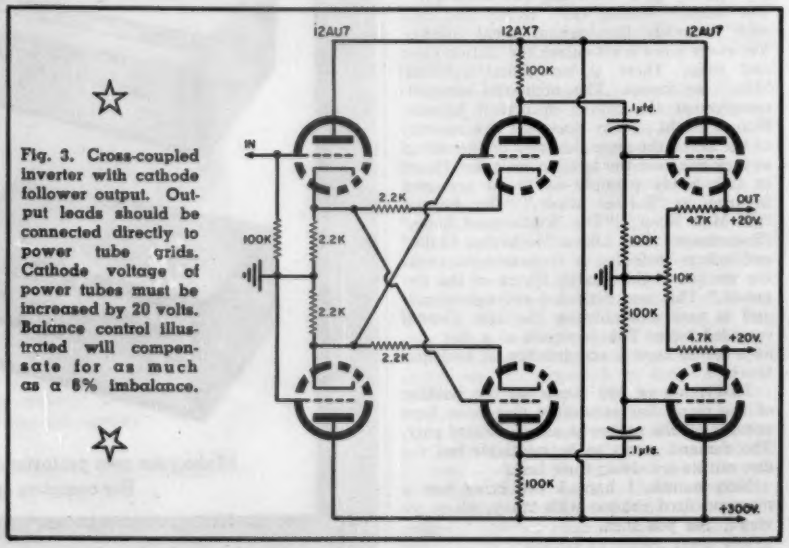

Fig. 3. Cross-coupled inverter with cathode follower output. Output leads should be connected directly to power tube grids. Cathode voltage of power tubes must be increased by 20 volts. Balance control illustrated will compensate for as much as a 6% imbalance.

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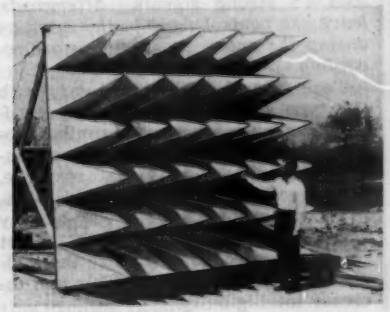
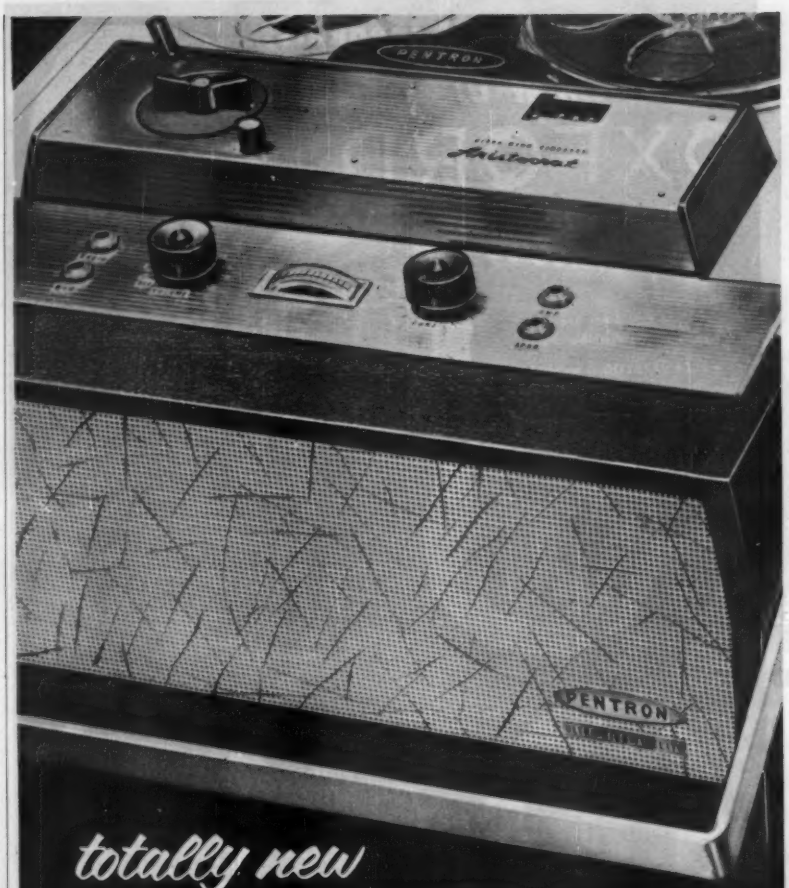
Also, the term "inherent balance" is somewhat misleading. Referring again to Fig. 2, it will be noted that both halves of the signal are equal only at the input of the second stage. This leaves variations in tubes and load resistors of the second stage to upset the balance. Another problem in the design is the high (30,000-ohm) output impedance which limits the high-frequency response and causes clipping as grid bias reaches zero in the power output stage.

Both of these problems can be solved simply by the addition of another cathode follower to the circuit. Because of the low d.c. voltage at the output of the cathode follower, it can be direct-coupled to the power stage without many of the problems of bias and static balance that usually accompany direct coupling. Direct coupling here eliminates a low-frequency phase shift point thus maintaining the stability of the amplifier. The low output impedance reduces high-frequency shift and allows some power to be delivered to the power stage. It can also be shown by the design equations for cathode followers that the gain of the stage can be varied by variations in the cathode resistance. This provides a very convenient method for balancing the dynamic characteristics of the amplifier, as shown in Fig. 3. Operation of this control will cause a slight static imbalance in the power stage. It should be negligible, but the purist may compensate for it by a corresponding adjustment in the balance control of the power stage, if one is provided.

The main fault of this inverter is its low gain due to the two cathode followers. Most modern tuners and preamps, however, deliver enough voltage to drive it to full output. In general, this inverter should satisfy every requirement in amplifiers where less than 15 volts' drive is needed at the power stage grids. —30—

Although the unusual looking wall shown below appears as though it might be going into an anechoic room that is to be used for loudspeaker and sound measurements, such is not the case here. Instead the large wedge-shaped objects are designed to perform the very same function for microwave radio-frequency energy. Hence if it is desired to simulate a field-free room that might be needed to take microwave antenna or transmitter measurements, these wedges could be used to line the room walls. The units shown below are a series of Eccosorb microwave absorbers which are mounted on a 12 by 12 foot metal covered wall. These pyramidal absorbers will reflect less than 2 per-cent of incident energy at all frequencies over 50 megacycles. They are useful where it is desired to have absorption for a broad frequency range.





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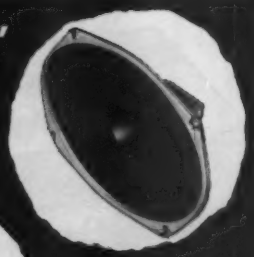

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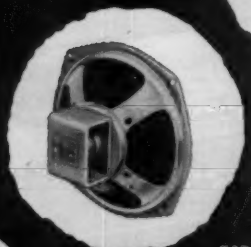

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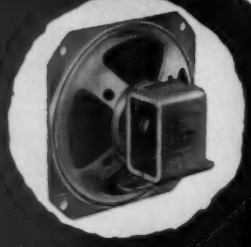

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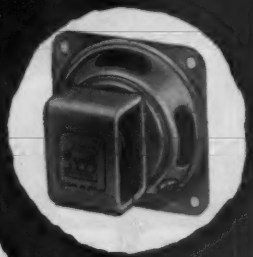

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Tape Recording

(*Continued from page 48*)

If you use the connection shown in Fig. 1A, keep the shielded connecting cable as short as possible to avoid loss of the high-frequency signals in the cable. Where the recorder and receiver may be some distance apart or where a fairly long connection must be used, say 20 feet or more, the arrangement shown in Fig. 1B is the preferable one.

(EDITOR'S NOTE: *An important precaution must be mentioned here if connection is to be made to an a.c./d.c. set or to a set with a "hot" chassis. If the power plug of the receiver is inserted in such a way that the ungrounded side of the a.c. line is connected to the chassis, then the ground connection that is indicated in Fig. 1 will make the tape recorder chassis and possibly some of the exposed mechanism "hot" with a.c. Under these conditions, contact between the tape recorder and ground (outlet cover plate, water pipe, radiator, etc.) will result in a serious shock. Therefore, when using a.c./d.c. sets or those having "hot" chassis, it is important that the power plugs of such sets be inserted into the outlet in such a way that the chassis is "cold," or at true ground potential, before making any external connections. With transformer-operated receivers, it is not necessary to observe such precautions.*

A simple method that can be used to check whether the chassis is "hot" is to measure the voltage between the chassis of the receiver and the nearest ground. This may be done with a neon bulb tester or with a voltmeter. If it is found that full line voltage exists between chassis and ground, then the power cord of the receiver must be reversed in its outlet. Mark the plug so that it will always be properly inserted.)

Recording Techniques: Basically, the technique of recording programs off-the-air is the same as that of conventional recording, using a microphone, with but a few minor variations.

First, since the broadcast material has already been "monitored" at the studio, it is not necessary for the recordist to "ride gain." Simply set the volume (gain or level) control of your recorder so that the unit does not overload on strong signals. *Afterwards, leave the control fixed in this position during the entire program you are recording.*

Tone control settings will vary with the type of material you are recording. For music, opera, and similar program material, adjust the tone controls for reasonably flat response. When recording voice, such as speeches, news, panel discussions, play-by-play accounts of sports events, etc., adjust the tone control to emphasize the middle range of frequencies. This will increase intelligibility.

The choice of recording tape and reel size is important and will vary with the program being recorded. In general, it is best to select a reel size which will permit an entire program to be recorded without the need for changing or reversing the tape. If you must change tape during a broadcast, try to do this during a station break or a commercial.

If you find that a large reel of standard recording tape will not hold all the program material you wish to record, you can use the newer "extended play" tapes. These magnetic recording tapes are made on a tough, but very thin "Mylar" (polyester) base which permits a great increase in the capacity of a given size reel, hence the increase in over-all recording time. See Table 1.

While you'll want to record all of the material offered on the program of your choice, chances are you'll want to omit most station breaks and commercials. There are several techniques for doing this.

If your recorder is designed for "dictation" work and thus is able to handle sudden starts and stops, you can simply stop the recorder during these periods. Not all recorders are designed for this type of operation, however, and an alternate technique must be used.

A satisfactory method is to note the volume (gain) setting you are using (or it can be marked with a small bit of cellophane tape), then turn the volume all the way down during commercials while allowing the recorder to remain in operation. As soon as the commercial is completed, the volume control can be returned to its original setting. With this technique, commercials are recorded as "silent periods."

In case your recorder is equipped with both microphone and tuner input jacks and you have separate volume controls for each input, you can fade out the program material during a commercial and fade in your microphone. You can then use these breaks to interject comments of your own. Such periods are ideal for describing costumes, scenery, and stage settings when recording the audio portions of TV programs.

If you would like to use this technique, but don't have separate controls, you can use an auxiliary mixer to combine the two signals. Such instruments are available as accessories through most radio parts distributors.

A final technique is to record the entire program, commercials and all, then edit out the unwanted portions of the program at some later date. Splicers, editing materials, and similar accessories can be added to your off-the-air recording set-up whenever you wish.

As you gain experience in making your own off-the-air recordings, you'll soon find that you can develop many special techniques of your own. Each new technique and each new "trick" will add greatly to your enjoyment of this exciting hobby. —30—

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Wherever feedback is a problem, the choice of a directional microphone is virtually automatic. Only the directional pickup pattern can effectively reduce or eliminate feedback. Furthermore this pickup pattern greatly reduces the pickup of distracting random noises. For floor stand usage, the directional microphone, with its ultra-cardioid pickup pattern, provides far greater freedom for the performer. In the moderate price range, the UNIDYNE is the perfect microphone choice among directional microphones. It is a uni-directional dynamic microphone, and it reduces the pickup of random noise energy by 67% . It is the ideal selection for use with fine-quality public address systems, and its high output permits its use even with low gain public address systems and tape recorders. It has a smooth frequency response from 50 to 15,000 cps.

For applications where versatility is important, the omni-directional probe microphone is the recommended choice. A night club performer, for example, who roams around a large area while he performs, would find such a unit more convenient. The SLENDYNE, for example, can be used in the hand, on a floor or desk stand, or worn around the neck, and can easily be changed—in seconds—from one application to another. Its unobtrusive design permits it to be held close, yet it remains in the background, leaving the spotlight to the performer. It offers a choice of impedance, an optional on-off switch, and a frequency range from 60 to 13,500 cps.

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120 High Output	Good	Very Good	Best	Good	Normal
120 AM High Output	Best	Best	Best	Good	Normal
190 Extra Play	Good	Good	Good	Best	Extended
150 Extra Play Weather Balanced	Best	Very Good	Good	Best	Extended

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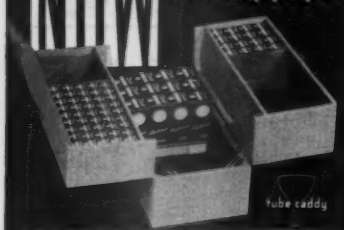

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Transistor Bridge Oscillator

By **DONALD S. BELANGER**

THE circuit to be described is the result of many hours of searching, building, and trying for an oscillator that would give pure sinusoidal output. For accurate bridge measurement, a pure sinusoidal input is a "must". Inductors and capacitors react differently to different types of waveforms, hence we have differentiation and integration but, to a pure sinusoidal voltage, the only change that takes place is in current and voltage phase relationships.

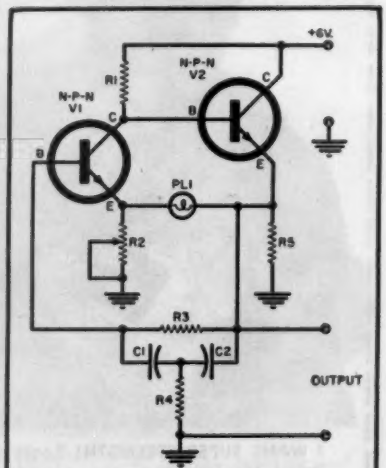
The transistors used in this circuit can be either *p-n-p* or *n-p-n* types. The original circuit used two *Sylvania n-p-n* 2N35 transistors. Other transistors, such as the CK722, CK721, 2N107, 2N170, 2N229, 2N94, TI-904, and 2N109, all performed equally well.

Current drain for the two 2N35's was 1.1 ma. with a 6 volt supply. Six volts seemed to be about the lowest collector voltage which would permit oscillation.

R_3, R_4, C_1, and C_2 form a notch network which determines the frequency of oscillation. PL_1 is a 3-watt, 117-volt lamp which keeps the output constant. R_2 is the regeneration control and is adjusted, while the output is fed to an oscilloscope, for purest sinusoidal waveform.

The frequency of 1000 cps may be altered by changing the capacity of C_1 and C_2. —30—

Bridge oscillator using "n-p-n" transistors. If "p-n-p" types are substituted for V_1 and V_2, battery polarity is reversed.



R_1, R_2, R_3—10,000 ohm ½ w. res. ± 10%
R_4—5000 ohm pot.
R_5—1800 ohm, ½ w. res. ± 10%
C_1, C_2—.033 μfd., 200 v. capacitor
PL_1—3 watt, 117 volt pilot bulb
V_1, V_2—"n-p-n" or "p-n-p" transistor (Author used 2N35's but any of the transistors mentioned in text can be substituted)

Sound on Tape

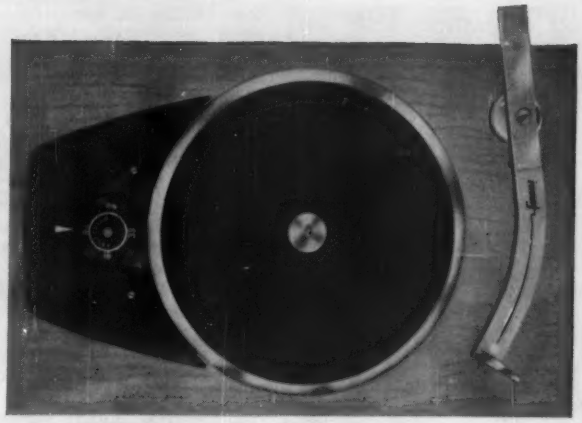
By BERT WHYTE

THINGS are popping in the world of recorded stereo tape. As the second major company in the field the *Mercury* announcement had the anticipated effect and *Capitol* quickly followed with an announcement of its stereo tapes. *Capitol* will issue both classical and pop material. Shortly after that *Vanguard* put its stereo show on the road and, as with *Capitol* and *Mercury*, will issue classical and pop. *Urania* has begun to issue stereo tape, and I have it on pretty reliable authority that *Columbia* and *Angel* stereo tapes will debut at the New York Hi-Fi Show. So the dam has broken at long last . . . no one can any longer decry stereotape as a restricted medium. My guess is that not long after the New York Show, most companies now producing discs will also be producing stereo tapes and then you can look for the first of the price breaks that will go a long way towards popularizing stereo on a mass basis.

KODALY
HARY JANOS SUITE
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury stereo MDS5-1. 7" reel, 7½ ips. NARTB tape curve. Price $12.95.

Yessir! The first of the *Mercury* stereo tapes and one of the most astounding recordings and fabulous listening experiences I've ever enjoyed. Superlatives are almost meaningless in describing the tremendous sound of this tape. I think I can safely say that in terms of sheer sound quality and the concomitant musical experience, this is the greatest recording I have ever heard. Strong language? Just wait until you hear this tape played on top quality equipment with big speakers, in a large room with proper acoustics.

What makes this tape so different? To begin with, this was originally recorded on three-channels on half-inch tape. This is to provide more gap area for each track and thus maintain a better signal-to-noise ratio. The three *Telefunken* mikes are set up especially so that their overlapping patterns cover the entire orchestra as regards "frontal" area. They are hung over the orchestra at an experimentally determined height and sonic focus. Thus *Mercury's* engineers are staying essentially within the bounds of their "Living Presence" technique they have used with such success on discs and now with stereo tape. By a special process, the third, or middle, channel has a certain number of decibels "ghosted" from it to each of the side channels. In the final two-track tape,



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electronically controlled and speed-regulated

Exciting, brilliantly engineered, the new Fairchild E/D brings to the turntable – a traditionally mechanical device – all the precision and accuracy of modern electronics.

Gone are the intricate couplings – the step-pulleys, cams, rubber wheels, etc. And gone with them are the principle causes of turntable distortion.

The new Fairchild E/D achieves a quality of performance beyond anything we have ever known. Rumble, wow and flutter become academic questions. They are virtually non-existent in the E/D. Speed constancy is maintained to an incredible accuracy – precisely regulated by an electronic power source. And the E/D's performance is entirely unaffected by variations in power line voltage and frequency.

PERFORMANCE SURPASSES ALL INDUSTRY STANDARDS

RUMBLE CONTENT
FLUTTER CONTENT
SPEED REGULATION
} 100% better than NARTB standards – better even than standards specified for primary professional recording equipment.

HOW IT WORKS

In the new Fairchild E/D turntable speed is changed by changing the speed of the hysteresis-synchronous motor. The speed of the motor is changed by altering the frequency of the current used to drive it.

This current is furnished by a variable-frequency oscillator-amplifier, called the Electronic Control-Regulator. Four frequencies are available which operate the turntable at 16⅔, 33⅓, 45 and 78 rpm respectively. Individual controls also permit the user to adjust each speed ±5%.

The Fairchild E/D can be operated from any AC power line supplying 85 to 135 volts. It can be operated with DC, using a converter – or with storage batteries and a vibrator-inverter. No matter which source is used, the quality and accuracy of turntable performance remain the same.

The Turntable Unit, which incorporates the turntable, hysteresis motor and 2-belt drive, can be purchased without the Electronic Control-Regulator (ECR) and used as a high quality single-speed 33⅓ rpm turntable from a 60-cycle power line. The ECR can be obtained at a later date, and easily mounted in the unitized turntable enclosure.

PRICES ARE: Fairchild E/D complete, $186.50; Turntable Unit (less ECR), $99.50; Electronic Control-Regulator (ECR) $94.00; Hardwood Base (shock-mounted) in walnut, mahogany or korina, $31.50.

See your Fairchild dealer for a demonstration. Literature on request. FAIRCHILD Recording Equipment Co., 10-40 45th Avenue, L. I. C. 1, N. Y.

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mentioned in text can be substituted)

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this results in a virtually unbroken sonic "front," with the orchestra properly spaced including the middle instrumentalists. Thus the long-despised "hole-in-the-middle" effect is almost completely neutralized. Is it as good as a genuine three-channel stereo tape? No . . . there are still factors above and beyond the "hole-in-the-middle" problem in which the third channel effectively increases realism. But it is awfully close, and I can say this sincerely since I have heard both the two- and three-channel tapes.

The most immediate and apparent feeling you get from these new *Mercury* stereos, is the utterly unbelievable clarity and definition of the orchestra, projected very much forward and seemingly spread right before your eyes. In many stereo tapes, in their striving for illusion, the sound becomes "distant" and somewhat formless. There is none of that phenomenon here. The acoustic perspective is as broad and spacious as usual with *Mercury* recordings, but at the same time has this tremendous projection and infinitude of detail. Another aspect is the brightness and color and texture of the sound. The ultra-wide frequency range and dynamics, the superbly clean transient response, and the lack of distortion which characterize the *Mercury* disc recording is as apparent in the tape, but even to a greater degree. With no lateral swing of stylus to restrict them, the dynamic range and transient response of the tape is simply fantastic.

Directionality in these tapes is nigh perfect, with the added plus that certain phasing problems in duplication have been overcome so that a given instrumental sound stays in its proper place and doesn't jump between speakers, as has happened with some stereo tapes. The "Hary Janos Suite" is a perfect vehicle for hi-fi and stereo and as the work unfolds effect is piled upon effect until you are literally staggered. In the "Battle and Defeat of Napoleon" and in the "Entrance of the Emporer and his Court" sections are some of the most amazing sounds ever recorded. There are massed trumpet and trombone fanfares and chordal motifs which are so realistic as to defy credulity. You can *feel* the wave envelope as the huge open brazen blare hits you! You can hear things you never noticed before . . . the gutteral snarl of the trombone is almost palpable as fundamental is augmented by harmonics. The characteristic vibrato of woodwind is clearly and cleanly discernible, as are the harmonics and overtones of the flutes and piccolos which are heard in stratospheric register at the beginning of the "Emperor's Court" scene. Strings are suddenly alive with accents and harmonics and even little rosin squeaks and squiggles, and their individuality is assured. First and second strings, the celli, violas, and contrabassi all speak from their appointed places with rich and sonorous voices. Percussion is stupendous. Snares,

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ALL-TRANSISTOR FRONT END
Completely eliminates HUM and MICROPHONICS.

MATCHED FUNCTION OUTPUT CONTROL
Selects either 1 or 3-volt output for best Signal-to-Noise Ratio when used with ANY BASIC AMPLIFIER regardless of rated output or sensitivity.

MINIATURIZED CHASSIS
Measures only 8" by 5⅛" x 2¾" with completely separate power-supply.

CHECK THESE FEATURES

HUM — Non-Measurable.

NOISE — Non-Measurable in 1-volt position.

GAIN — 10 mv in phono for 3 volts at 1000 cps. 100 mv in tape and tuner positions for 3 volts output. 300 mv in Aux position for 3 volts output.

FREQUENCY RESPONSE — Plus or Minus 0.25 db, 20 tp 20,000 cycles.

FILTERING — Rumble and Noise Filters with 12/db octave slope. Rumble: 50 and 100 cycles; Noise: 4 and 8 kilocycles.

TONE CONTROLS — Variable crossover feedback type.

DISTORTION — For 1 volt output; in the order of 0.2%

LOW IMPEDANCE OUTPUT

EQUALIZATION — RIAA in phono, with settings for LP, AES, and EUR. NARTB 7½" per second tape playback characteristics.

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channels. In the final two-track tape,

tympani, cymbals, and bass drum have tremendous weight and impact if called for, or are completely articulate even at the most *piano* moments. In the drum rolls of the finale, there is a dynamic build-up which is almost terrifying.

Surely no record groove could ever accommodate this unbelievable outpouring of low-frequency sound. The 48 inches of woofer on my big *Bozak* was literally puffing blasts of air at me! The totality of sound is nothing less than awesome and I have played this for people who quite honestly were open-mouthed in astonishment. Incidentally, as I have noted before, even though this was played at a big room-filling level, none of the ladies objected! Ah, the magic of stereo! Well I think you get the general idea. The performance under Dorati is definitive and the orchestra is supremely accomplished. Beg, borrow, or steal . . . but somehow hear this tape for a hi-fi thrill you won't soon forget.

"NEW GIRL IN TOWN" (HIGHLIGHTS)
Gwen Verdon, Thelma Ritter, George Wallace, Cameron Prud 'Homme and original cast. Victor CPS79 stereo. 7" reel, 7½ ips. NARTB tape curve. Price $10.95.

With all these new companies getting into stereo tape, *Victor* who started it all has not been idle. For instance, here is the first venture into the field of the Broadway play. There may be people who would argue that stereo or not, a Broadway musical is not an ideal subject . . . that there is too much action to encompass. Maybe they are right, but I've played this tape for a good many people, some hep to hi-fi and some not hep to hi-fi or Broadway musicals for that matter. In every instance, the auditors enjoyed the tape and commented on the clarity and distinctness of the singing and the enunciation while speaking and the bright sound of the orchestra.

All were impressed by the manner in which the stereo let you follow the action of the actors from one point on the stage to another. To be honest with you, I don't particularly care for this rather blatant, rah rah, type of musical, but I even found myself enjoying it. There is not much question that stereo is mighty effective in sustaining action and in keeping the important speaking and singing articulate. With the wide frequency range and the stereo effect, the "on stage" presence was superior to any disc musical I've ever heard. From my experience *Victor* should be encouraged and I hope more of the same will be forthcoming.

TCHAIKOVSKY
VIOLIN CONCERTO IN D MAJOR
Erica Morini, violinist, with Philharmonic Symphony of London conducted by Artur Rodzinski. Sonotape stereo SWB8016. 7" reel, 7½ ips. NARTB tape curve. Price $15.95.

Sonotape, another earlier comer to stereo, continues to issue some superb material. A case in point is this ab-

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DAMPING FACTOR—Variable from 0.5 to 10.
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solutely magnificent recording of the popular Tchaikovsky violin concerto. This is, without doubt, one of the most totally effective recordings of a violin concerto ever recorded. The solo violin of Erica Morini is a fascinating study in sonorities all by itself. Through the wide-range magic of stereo you can appreciate the smooth richness of her tone, pick up subtleties and nuances of bowing and fingering, quite unheard in disc recordings; follow her when she bridges or mutes, thrill to the electric attacks with their gutty resonance.

Add to all this the knowing and sympathetic accompaniment of Artur Rodzinski. The stereo highlights a trumpet here, a brace of horns there . . . woodwind steals sweetly on the scene . . . the orchestra's first strings soar upward on the left and the celli answer darkly from the right. All the while the dazzling interplay between soloist and orchestra continues, Miss Morini standing revealed to us just slightly left of center. Yes, directionality in this tape is most helpful in maintaining the feeling of "on the spot" performance.

This is one of the biggest sounding *Sonotapes* yet. Recording was fairly close-up but good spacious acoustics were allied for liveness and served to highlight the excellent orchestral detail. Dynamic range was impressively wide and when soloist and orchestra are in full cry in the finale the realism will make your hair stand on end. If you love the violin concerto, this is for you and is unreservedly recommended.

MUSIC FOR A QUIET MOOD
Marco Gregory and his Orchestra. Concert Hall CHT/BN34 stereo. 7" reel, 7½ ips. NARTB tape curve. Price $11.95.

I guess a great many people must think that all stereo is good for is the big works with plenty of moxie and oomph. I confess to being guilty in fostering this notion. Of course stereo is applicable to almost any kind of music and will most certainly enhance your enjoyment. This *Concert Hall* tape will neatly fill the bill for anyone who should want some light music for background. What . . , stereo for background? Why not? I'll grant that many of stereo's attractions will be missing, but one of the big advantages of stereo is that at low listening levels, balance is fairly well maintained and definition does not suffer. Of course you can turn up the level on this tape and enjoy all the stereo advantages to your heart's content. However with numbers like "Sleepy Lagoon," "Narcissus," "Pizzicato Polka," "Rustle of Spring" and "Valse Triste" among others, you can see the obvious uses of such a tape. The orchestra plays quite nicely, acoustics are spacious, and detail bright and clean. Directionality is there if you want it and, in general, the stereo aided this innocuous music in sounding quite enjoyable. It is surprising how many people want to buy this type of stereo tape and there is very little available. —30—

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The Very Best in Sound . . .

With these three simple elements you can build your speaker system, step-by-step if you wish, into the crowning achievement in the re-creation of sound — a Bozak B-310 or B-400. Infinite baffling means unlimited flexibility — and at each stage of growth the sound is unchallenged in its class.

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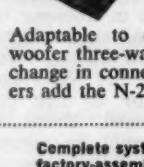
The only speaker made specifically for the middle frequencies. For maximum precision in the middles, add it to one or more B-207A's.



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Complete systems are available factory-assembled in infinite-baffle enclosures, or you can build your own from plans on request. The 5-cu-ft E-300 cabinet comes as a complete kit for only $42.50

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material. A case in point is this ab-

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Within the Industry

(*Continued from page 28*)

23rd Street, New York, N. Y. The new telephone number is: Algonquin 4-3532.

The association's executive secretary and director of shows will occupy the new suite of offices.

* * *

P. R. MALLORY & CO., INC. of Indianapolis, Ind., and **RADIO MATERIALS CORPORATION,** Chicago and Attica, Ind., have agreed on a merger, or pooling of interests. The Chicago and Attica firm is to operate independently as a separate division of the Indianapolis organization . . . The consolidation of one of the country's oldest electronics distributors with a nationwide marketing firm has been announced. Majority stock of **RADIO SPECIALTIES CO.,** electronics distributor in southern California, has been acquired by **SHALLWAY CORPORATION,** Connellsville, Pennsylvania . . . Acquisition of **CG ELECTRONICS CORPORATION,** Albuquerque, N.M., by **GULTON INDUSTRIES, INC.,** has been announced. The firm will retain its corporate identity, operating as a wholly owned subsidiary of the parent organization . . . A new electronic equipment manufacturing firm has been formed in Santa Barbara, California. The company, to be known as **C SCIENTIFIC COMPANY,** will locate its plant at the Santa Barbara Airport in Goleta, Calif.

* * *

GOODWIN MILLS has been elected vice-president of *Knight Electronics Corporation* . . . *Rek-O-Kut, Inc.* has appointed **CLIFFORD SHEARER** director of marketing . . . The appointment of **RICHARD W. GRIFFITHS** as director of sales for the components division of *Litton Industries* has been announced . . . **MILTON M. KANTER** has been named assistant to the vice-president and secretary of *Ford Instrument Company,* division of *Sperry Rand Corp.* . . . *Cletron, Inc.,* division of *Cleveland Electronics,* announces the appointment of **ALLEN S. JOHNSON** as sales manager for the firm's line of loudspeakers, speaker kits, hi-fi enclosures, and related electronic equipment . . . Promotion of two top executives of *General Precision Laboratory, Inc.* has been announced. **DR. RAYMOND L. GARMAN** is now chairman of the board, and continues as technical director in charge of research and development, and **JAMES W. MURRAY** has been elected president and chief executive officer, continuing as general manager . . . The election of **C. F. PARSONS** as vice-president, sales, *RCA Victor Distributing Corp.,* has been announced by the company . . . **JAMES F. YOUNG** has been appointed assistant secretary of *Waveforms, Inc.* . . . **KIRBY DAWSON** has been named assistant to the sales manager and director of export sales at *Kaar Engineering Corp.* . . . The following directors have been re-elected to the board of *Alpar Manufacturing*

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The TWO meters of THE FISHER 80-T (for micro-accurate tuning) are typical of the outstanding specifications that have won its acclaim as today's most advanced, professional tuner. The 80T includes complete audio controls. The roster of those who use THE FISHER includes leading organizations in research, broadcasting and educational fields. THE 80-T provides a level of performance that far exceeds even *their* most critical specifications. These same high standards of performance, together with the uncompromising quality of workmanship for which THE FISHER is famous, are available to you, for use in your own home. Hear it now, at your dealer's! $199.50

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Outstanding Features of THE FISHER Model 80-T

■ The Model 80-T features extreme FM sensitivity—1.5 micro-volts for 20 db of quieting. ■ Full limiting on signals as low as one microvolt. ■ Separate FM and AM front ends, completely shielded and shock-mounted. ■ Separate tuning meters for FM and AM. ■ 72-ohm, plus exclusive balanced, 300-ohm antenna inputs for increased signal-to-noise ratio. ■ Supplied with AM loop and FM dipole antennas. ■ Adjustable AM selectivity. ■ AM sensitivity better than one microvolt for full output. ■ Inherent hum non-measurable. ■ Distortion below 0.04% for 1 volt output. ■ Four inputs. ■ Separate tape-head playback preamplifier (with NARTB equalization.) ■ Preamplifier-Equalizer has sufficient gain to operate lowest level magnetic cartridges. ■ Six choices of record equalization. ■ Multiplex and cathode follower outputs. Frequency response, on FM, within 0.5 db, 20 to 20,000 cycles. ■ Super-smooth flywheel tuning mechanism. ■ 16 tubes. ■ EIGHT CONTROLS: Selector, Variable AFC/Line Switch, Station Selector, Bass, Treble, Equalization, Volume, 4-Position Loudness Contour. ■ Self-powered. ■ DC on all audio filaments. ■ Beautiful brushed-brass front panel. ■ SIZE: 12¾" wide x 8¾" deep x 6" high. ■ WEIGHT: 21 pounds.

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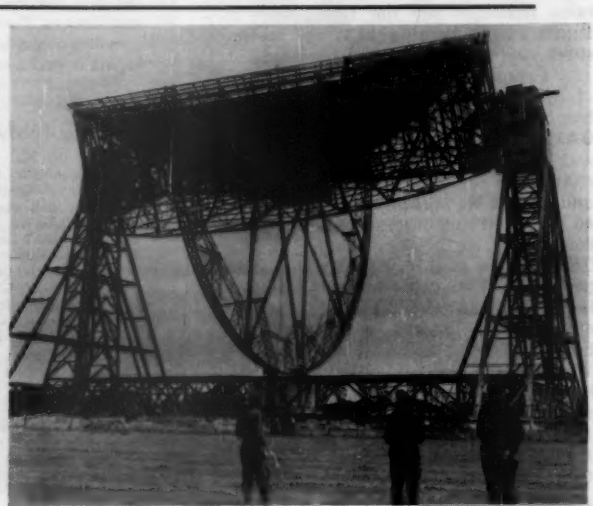
Corp.; **W. W. EITEL,** president of *Eitel-McCullough, Inc.;* **D. O. JOHNSON,** formerly vice-president of *National Motor Bearing Co.;* **A. M. PONIATOFF,** chairman of the board of *Ampex Electric Co.;* **C. R. PARMENTER,** vice-president of the firm; and R. V. Laustrup, president . . . *Datamatic Corp.,* wholly owned subsidiary of *Minneapolis-Honeywell Regulator Co.,* has elected **JOHN R. LENOX** vice-president in charge of operations . . . **WILBUR W. BLODGETT** has been named director of marketing for *Tele-Beam Industries . . . Winston Electronics, Inc.* announces the appointment of **ROBERT M. REED** as assistant national sales manager . . . **ARCHIE F. BOSCIA** has been named chief product engineer for *Kin Tel Division* of *Cohu Electronics, Inc.* . . . The election of **ROBERT PELZ** as secretary of *Gulton Industries, Inc.* has been announced . . . *The Rauland-Borg Corp.* announces the resignation of **R. M. "ROCKY" GRAY,** sales manager of the firm for the past 16 years . . . **GORDON P. FELTS,** president and chief engineer of *Microdot, Inc.* has announced his retirement from the firm upon reaching 65 . . . **KJELL GAARDER,** recording industry pioneer and member of *V-M Corporation,* died recently at the age of 56.

* * *

COLLINS RADIO COMPANY announces that it will begin construction of a 235,000-square-foot manufacturing plant at Cedar Rapids, Iowa. The new plant will be located on a 90-acre tract opposite the company's engineering laboratory . . . **WESTINGHOUSE ELECTRIC CORPORATION** will build a new manufacturing and repair plant in Charlotte, N.C. The 24,000-square-foot building will be located on a 6½ acre site . . . **DIAMOND ANTENNA AND MICROWAVE CORPORATION** has procured an additional 5000 square feet of floor space within its presently occupied building for the purpose of expanding its engineering and laboratory staff and associated facilities . . . **AMERICAN CENTER FOR ANALOG COMPUTING** has been established at 127 Clarendon Street, Boston, Mass. It will be operated by **PI-SQUARE ENGINEERING COMPANY, INC.** . . . **MOTOROLA INC.** has begun the construction of a two-part addition to the firm's present housing in Franklin Park, Ill. . . . The electronic distributor sales division of **ERIE RESISTOR CORPORATION** has enlarged its quarters . . . **WARD PRODUCTS CORPORATION,** electronics division of **THE GABRIEL COMPANY,** has located its manufacturing facilities in a new plant in Amsterdam, N.Y. . . . **BURNELL & CO., INC.** has moved to Pelham Manor, N.Y. . . . Ground has been broken by **SYLVANIA-CORNING NUCLEAR CORP.** for a new plant to manufacture nuclear fuel elements for atomic reactors. The firm is a jointly-owned company of **SYLVANIA** and **CORNING GLASS WORKS** . . . The electronic instrument manufacturing and distribution activities formerly conducted by the instrument division of **FEDERAL TELEPHONE AND RADIO COMPANY,** an **I T & T** division, have been assigned to the recently created industrial products division of the parent organization . . . **DYNA COMPANY** has moved to a new plant at 617 North 41st St., Philadelphia 4, Penna. . . . **RICHARDS ELECTROCRAFT, INC.,** is tripling its manufacturing area in a new location at 4432 North Kedzie Ave., Chicago, Ill. . . . **TRACERLAB, INC.** announces the opening of a new sales office at 7122 Jamieson Ave., St. Louis, Mo. . . . **RAYTHEON MANUFACTURING COMPANY** will add a fourth more space to its Maynard, Mass. laboratory . . . **WELLER ELECTRIC CORPORATION** will centralize all production, sales, and administrative operations at its present general offices in Easton, Penna. New facilities will be erected to quadruple the space of the present 12,000-square-foot building . . . **EICO** has moved to new and larger quarters at 33-00 Northern Boulevard, Long Island City 1, N.Y. . . . **GENERAL ELECTRIC CO.** is broadening the scope of its distributor sales organization. Sales offices will be moved from Schenectady to Owensboro, Ky., which now is headquarters for the components division of the company. —30—



Nearing completion at Jodrell Bank, Cheshire, England is this radio telescope claimed ten times more powerful than any other in existence. Being built for Manchester University for the exploration of the skies by radio astronomy, the lensless telescope is expected to be able to reach out into space for a distance of a billion light years and to follow automatically a star's course across the skies.

lowing directors have been re-elected to the board of *Alpar Manufacturing*

FISHER RADIO Corporation 21-23 44th Drive, L. I. City 1, N. Y.

Noise-Compensated Car Radio Volume

Motorola circuit adjusts to speed automatically.

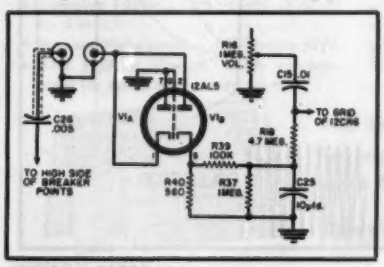
AS THE speed of an automobile increases, noise in the car's interior also mounts. Anyone who has driven with the radio going has taken subconscious note of this fact: the driver's right hand has to reach out to turn up radio volume in order to make the sound output intelligible when travelling speed is increased. Conversely, when the car slows down and the masking noise subsides, level becomes uncomfortably high and must be turned down manually.

A simple circuit, requiring a twin diode, has been developed by *Motorola* engineers to overcome this annoyance. It has been incorporated in Model 79MS, designed for original installation in *Ford* "Thunderbird" cars.

The circuit takes advantage of the fact that the number of revolutions per minute of the engine is directly related to speed of travel. This means the frequency of pulses in the ignition system also varies with car speed. Accordingly, positive pulses are taken off from the high side of the breaker points and fed to the 12AL5 in the accompanying schematic through capacitor C_{28}. Any undesired negative pulses at this point are shorted out by diode V_{14}. Positive pulses are rectified by V_{13}, with the rectified voltage being dropped across cathode resistor R_{40}. Filtering converts these pulses into a steady d.c. voltage, which is applied to the grid of the 12CR6 audio amplifier in common with the manual volume control.

In use, the operator determines the primary operating point of the audio amplifier by manually setting the volume control. As car speed (and ambient noise) increases, the pulses applied to the diodes increase in frequency, resulting in increased positive voltage built up across C_{28} and thence applied to the grid of the amplifier. This biases the 12CR6 for increased volume to over-ride the noise level. As speed falls off, this voltage drops, correspondingly reducing volume to match the reduced noise level. —30—

Ignition pulses bias audio stage.



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Slightly Higher in Far West

Outstanding Specifications of THE FISHER Model 80-AZ

■ Handles 30 watts; 60 watts peak! ■ Three separate feedback loops for stability and low distortion. ■ Less than 0.5% distortion at 30 watts; less than 0.15% at 25 watts; 0.05% at 10 watts. ■ IM distortion less than 0.5% at 25 watts; 0.2% at 10 watts. ■ Frequency response uniform within 0.1 db from 20 to 20,000 cycles; 1 db from 10 to 100,000 cycles. ■ Hum and noise *virtually non-measurable*—better than 95 db below full output. ■ CONTROLS: Z-MATIC and Input Level. ■ TUBE COMPLEMENT: 1-12AT7, 1-12AU7, 2-EL37, 1-5V4G. ■ OUTPUT IMPEDANCES: 4, 8 and 16 ohms. ■ SIZE: 4¼" deep, 15½" wide, 6⅞" high. ■ SHIPPING WEIGHT: 22 pounds.

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Admiral— built into more phonos and combinations than any other changer in the world!

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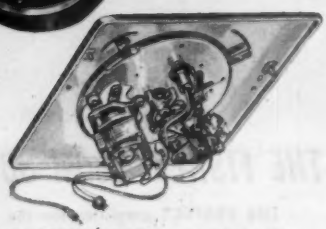
Hi-Fidelity

Beige and Coral with Golden trim (Base Optional)

- **PLAYS ALL FOUR SPEEDS**—33⅓, 45, and 78 plus "talking book" 16⅔ r.p.m. Has neutral position. Changes 12 to 14 records; intermixes those of same speed. Automatic 2-way shut-off after last record. Returns tone arm to rest, stops turntable motor completely. NOTE: Can be wired to shut-off radio or amplifier chassis.
- **RUBBER TURNTABLE MAT**
- **FEATHERWEIGHT TONE ARM**—new resonance-free design. Less than ⅓ oz. pressure. Positive tracking . . . no "skip" or "jump" on loud passages.
- **DIAMOND LP STYLUS**—separate LP diamond and 78 r.p.m. sapphire needles for finest sound reproduction, long record life.
- **ATTACHED 40" SHIELDED AMPLIFIER CABLE**—eliminates pickup of unwanted noise. Cable has phono tip plug for quick easy connection into standard input phono-tip jack.



HEAVY DUTY MOTOR—powerful 4-pole constant speed shaded pole induction type motor. Operates without hum, rumble or "wows" (as little as 0.1590). Maintains even speed even if line voltage varies. Six foot line cord attached.

CERAMIC PICK-UP CARTRIDGE—twin lever hi-fi cartridge changes with flick of the finger from LP to 78 r.p.m. needle. Impervious to heat and humidity. High lateral compliance minimizes wear, eliminates hum and distortion. Smooth even response (± 3db) over the full high-fidelity frequency range (30-15,000 c.p.s.).

Write for Illustrated Specification Sheet.

Admiral. / SPECIAL PRODUCTS DIVISION
3800 West Cortland Street
Chicago 47, Illinois

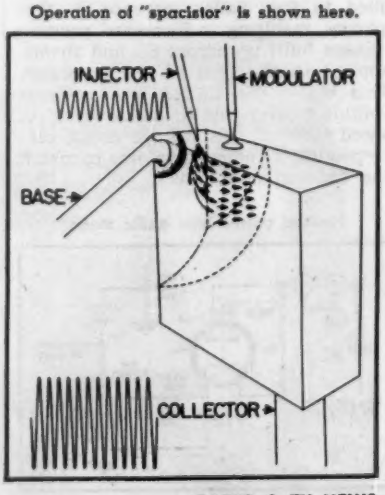
Experimental assembly of the Raytheon "spacistor" is shown beside ordinary pin.

"Spacistor" Combines Transistor and Tube Properties

May operate up to 10,000 mc. with very high impedances.

INVENTION of the "spacistor" was disclosed recently by a team of *Raytheon* physicists. The device is a semiconductor which is as tiny as a transistor and operates electrically like a tetrode vacuum tube. Still in the research stage, the new device promises two major advantages over today's best transistors. The research scientists predict the spacistor will amplify at frequencies up to 10,000 mc., as much as 50 times higher than transistors. Also they are expected to operate at temperatures as high as 500 degree C., or more than double today's germanium or silicon transistors. The spacistor retains the transistor advantages of operating on a fraction of vacuum tube power, having no filament to heat or burn out. Also, it can be tightly packaged. Finally, very high input and output impedances exist with the spacistor. —30—

Operation of "spacistor" is shown here.



Amplifier-Speaker System

(*Continued from page 59*)

The net result of this is that transients should sound much cleaner than from a conventional type of loudspeaker—in any kind of room. The feedback does not *eliminate* the standing waves. If it did, it would make any room sound like an acoustic test chamber—horrible! No, we do not want it to do that. We are used to rooms, and probably our listening room in particular, *as they are*. We do not want to have the loudspeaker eliminate room characteristics.

The manufacturer calls each one of the six transistor power amplifiers used in the stereo-monaural model a "servo amplifier" because this is just what the amplifiers are. Servo amplifiers, such as are common for industrial control or missile guiding purposes, are special amplifiers that handle "error" signals developed in the system as a result of the incorrect mechanical position or motion of some device in the system. The output of the amplifier is fed to some mechanism (called a servomechanism) in such a way that the error is corrected. In the case of this special loudspeaker system, the "error" signal is derived by feedback from the special sensing coil of the speaker. This signal is then compared with the original signal at the amplifier input. If there is a difference between the two, a correction is automatically applied.

The price of the Model 372 stereo-monaural system complete, including all transistor amplifiers and crossover network circuits, is $550, available in a variety of hand-rubbed oil finishes. Supplied with each unit is an individually certified speaker response and distortion curve. Also, to check on the 2000-hour unconditional guarantee of operation, each unit contains a 2000-hour timer. The timer, which is the same size and shape as an ordinary glass cartridge fuse, operates on the principle of electroplating metal from one electrode (at one end of the cartridge) to another (at the other end). A scale, marked in hours and printed on the cartridge, shows the electrode growth and hence the time the unit has been operating.

For those who are interested only in monaural reproduction, another model of the system is available (at $395) which is similar to the Model 372 except for the omission of one of the woofers and its associated circuitry. All specs for this unit are the same as for the other unit except for an acoustic output rating of .5 watt and amplifier output of 36 watts. Also a conversion kit is available for the monaural unit (at $195) permitting conversion to the stereo system. The kit consists of a 15-inch woofer, the required transistor amplifiers, power supply, switches, cables, wood parts, and instructions for conversion. —30—

SAVE ½ — PAY PART-BY-PART — HAVE FUN
Assembling the SCHOBER
ELECTRONIC ORGAN in KIT form

Now you can afford a real, full concert organ, just like those made by the foremost organ manufacturers. Because over ½ the cost is saved when you assemble it yourself. And it's REALLY EASY: only 24 separate units, all with printed circuits, and detailed-to-the-smallest-step instructions. In addition, you purchase each of the 24 kits when you are ready for it — and can afford it.

You'll get a real kick out of putting the Schober Electronic Organ* together — and then sitting down and pulling the stops for Strings, Trumpets, Clarinets, Diapasons, Flutes, etc. Electronic Percussion optional; chimes available.

Compact CONSOLE

One of the many exclusive features of this exceptional organ is the handsome console, in a wide variety of finishes. It is equally at home in a traditional or modern setting, and takes little more space than a spinet piano.

Free Literature

Complete descriptive booklet and price list are available on request. And, if you wish to hear the glorious pipe organ tone of the Schober Electronic Organ, a 10" long-playing demonstration recording is available for $2. This is refundable when you order. Write today and see what a fine instrument you can get at such a great saving.

The SCHOBER ORGAN CORP.
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*Designed by Richard H. Dorf

LIMITED QUANTITY
below manufacturer's cost!

60 WATT AMPLIFIER

MusiCraft Special

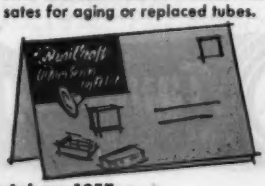
MusiCraft capitalized on a once-in-a-lifetime opportunity. Because this sale is limited, act fast. Look at the price... Check and compare the specifications... And share our enthusiasm! First run, quality components and construction.

SPECIFICATIONS

- IM Distortion....Less than 1% @ 60W.
- Harmonic Distortion....Less than 1% 20 cps. to 20,000 cps.
- Frequency Response....±0.5DB, 20 cps. to 20,000 cps.... ±1DB, 7 to 70,000 cps.
- Sensitivity....1.5 volts rms. for 60 watts.
- Damping Factor....choice of 15 or 30 by a switch.
- Hum and Noise Level....85DB below 60W.
- Hum Nullifier Control which compensates for aging or replaced tubes.

FEATURES

- Chrome plated chassis
- Choke filtered power supply
- Octal socket for preamplifier power connection (wired for Heathkit, Dyna-kit and other preamplifiers)
- Fuse receptacle on chassis
- Heavy duty power cord
- Biased filament supply
- Tubes: 2-6550, GZ34, 6BA8A
- Completely assembled, wired, and tested
- Dimensions—9" x 14" x 8" high. Shpg. Wt., 31 lbs.



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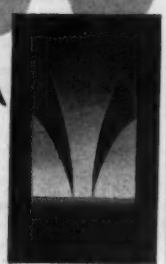

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Sherwood
TUNERS

Indeed the Ultimate! Under one microvolt sensitivity for 20 db FM quieting increases station range to *over* 100 miles with the newly engineered Sherwood tuners. Other important features include the new "Feather-Ray" tuning eye, a local-distance switch to suppress cross-modulation images, AFC switch, fly-wheel tuning.

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MODEL S-3000 FM only Tuner...$99.50 net

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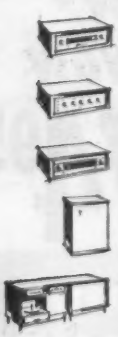

The "complete high fidelity home music center."

Dry-Cell Battery Charger

By JOSEPH CHERNOF

Unit will handle three 1.5 volt cells at once.

PRIMARY or dry cells have always been popular in low voltage and portable equipment, but never more so than now when transistor circuits are the big thing. The principal disadvantage of the dry cell has always been the relatively small amount of energy that can be obtained before replacement is necessary, particularly under continuous operation.

Several methods have been devised in the past for recharging dry cells so they can be used over and over. The original work on this problem was described by R. N. Eubanks in the June 1944 issue of "*QST*." Most of the recharging methods described, however, are similar to the trickle charger used with storage batteries and are only successful under fairly limited conditions. The dry cell must be recharged immediately after having been in fairly continuous use. Cells run down as a result of intermittent use over a long period of time or as a result of long shelf life usually cannot be satisfactorily revived.

In addition, unless the reverse current is kept very small and the reactivating process made a long, slow one, the cell may grow hot and burst. Another disadvantage of the trickle charger for dry cells is that the open circuit voltage after charging is usually 20 to 50 per-cent higher than the battery rating. This voltage then falls to the rated value after a few minutes' operation under load. This is of little importance in flashlight batteries, for instance, but might shorten tube life if the battery is to be used as filament supply in a portable radio.

The recharging method to be described here eliminates some of these disadvantages by borrowing some of the techniques which have been used in the electroplating industry for many years.

The schematic of the "improved" dry cell recharger is shown in Fig. 1. The circuit shown is suitable for recharging three 1.5 volt batteries, connected in series, or can be used with a 4.5 volt "C" battery. It is most convenient to charge a number of batteries at one time, since the process

THE SCANDINAVIA STYLED
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A tape recorder of distinctive design

Designed and built in accordance with the most advanced European Engineering Techniques . . . 3-speed (1⅞, 3¾, 7½ ips) half track tape recorder and playback unit—custom-crafted with a care that makes each one a perfectly produced image of the other.

A tape recorder of incomparable performance

Frequency response from 30 to 18,000 cps at 7½ ips; from 30 to 10,000 cps at 3¾ ips; from 50 to 6,500 cps at 1⅞ ips. Flutter and wow below 0.1% at 7½ ips and low enough at 1⅞ ips to be inaudible on piano recordings. Signal-to-noise ratio 60 db at high recording levels.

A tape recorder of superior value

It comes complete with fine luggage case, balanced playback amplifier, high fidelity Goodmans speaker, quality crystal microphone, heavy-duty input-output cord and 1,200 ft. reel of tape for only $299.50.

Ask your dealer for a demonstration or write for full information to:

Tandberg
10 E. 52nd St., New York 22, N. Y.

MusiCraft 48 East Oak St., Chicago 11, Ill., DElaware 7-4150

takes from 8 to 10 hours and the three-cell capacity provided here allows the use of a standard 6.3 volt filament transformer—a component which is usually to be found in most junk boxes.

As can be seen from the schematic, the unit is a simple one, consisting of a stepdown transformer, a 1N91 germanium rectifier shunted by a 220-ohm resistor, and a flashlight bulb which serves as the current regulator. Due to the shunting effect of the resistor, the resulting charging current is mainly a.c. with some pulsating d.c. Using this method, the final open-circuit voltage for the 1.5 volt cells is always 1.55 to 1.6 volts; the cells do not get hot during reactivation; and good results are obtained even with batteries that have been on the shelf or used intermittently for long periods of time.

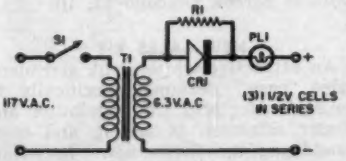
It has been found from taking apart cells that have been recharged in this manner and comparing them with cells that have received a trickle charge that the pulsating output voltage results in the zinc being more evenly and smoothly deposited and less "pasty" than with the pure d.c. from the trickle charger. This improved deposit of zinc is due to what is described in the electroplating industry as "electrolytic polishing". When a pure d.c. supply is used for electroplating, the deposit tends to be pasty and lumpy but if the current flow is periodically reversed, metal is removed from any sharp or loosely deposited areas in preference to the main deposit of metal, producing a firm and even layer.

Using the method described, cells may be recharged indefinitely, providing that the case is undamaged. Once the metal case has been perforated, the battery should be discarded. As previously mentioned, a recharging period of 8 to 10 hours, or roughly overnight, seems to give the best results although this time is not critical.

The recharger can be built into a chassis box as small as 6" x 4" x 3". Mounting clips for the three standard flashlight cells to be recharged are fastened on the outside of the case.

-30-

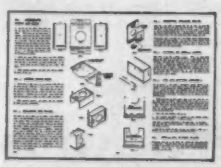
Fig. 1. Schematic of battery recharger unit.



R_1—220 ohm, 2 w. composition res.
S_1—S.p.s.t. toggle switch
PL_1—3. 2 volt, .16 amp pilot light (G-E miniature Type 1490)
T_1—Stepdown trans., 6.3 v. @ .6 amp secondary (Tried F-13X or equiv.)
CR_1—1N91 diffused junction germanium rectifier (G-E)

THE "Californian" SPEAKER ENCLOSURES *

PRE-FINISHED KIT only $40.50 AUDIOPHILE NET



The best looking, best engineered, and easiest-to-build economically priced kit we have ever seen!

The handsome wood finish of its St. Regis Panelyte top has grain and beauty sealed in. Not even a lighted cigarette can harm it. Users will thrill to the superb tone of Jensen's new Bass Ultraflex* design (richness without booming, and without damping the highs). Fully illustrated 4-page manual gives easy-to-follow step by step instructions.

The "Californian" enclosures are available as factory built cabinets or pre-finished kits. Top and bottom of kits are all finished —no painting, varnishing, sanding or covering required.

AVAILABLE TWO WAYS	FACTORY BUILT	PRE-FINISHED KITS
The Californian... 24x29x15 inches deep For 12" or 15" speaker AUDIOPHILE NET	DSE-1 $54.50	DSE-1K $40.50
The Californian Jr.... 19½x23½x13½ in. deep For 8" or 12" speaker AUDIOPHILE NET	DSE-2 $44.50	DSE-2K $32.50

Mahogany or Blonde same price
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* As completely described in August Radio & TV News

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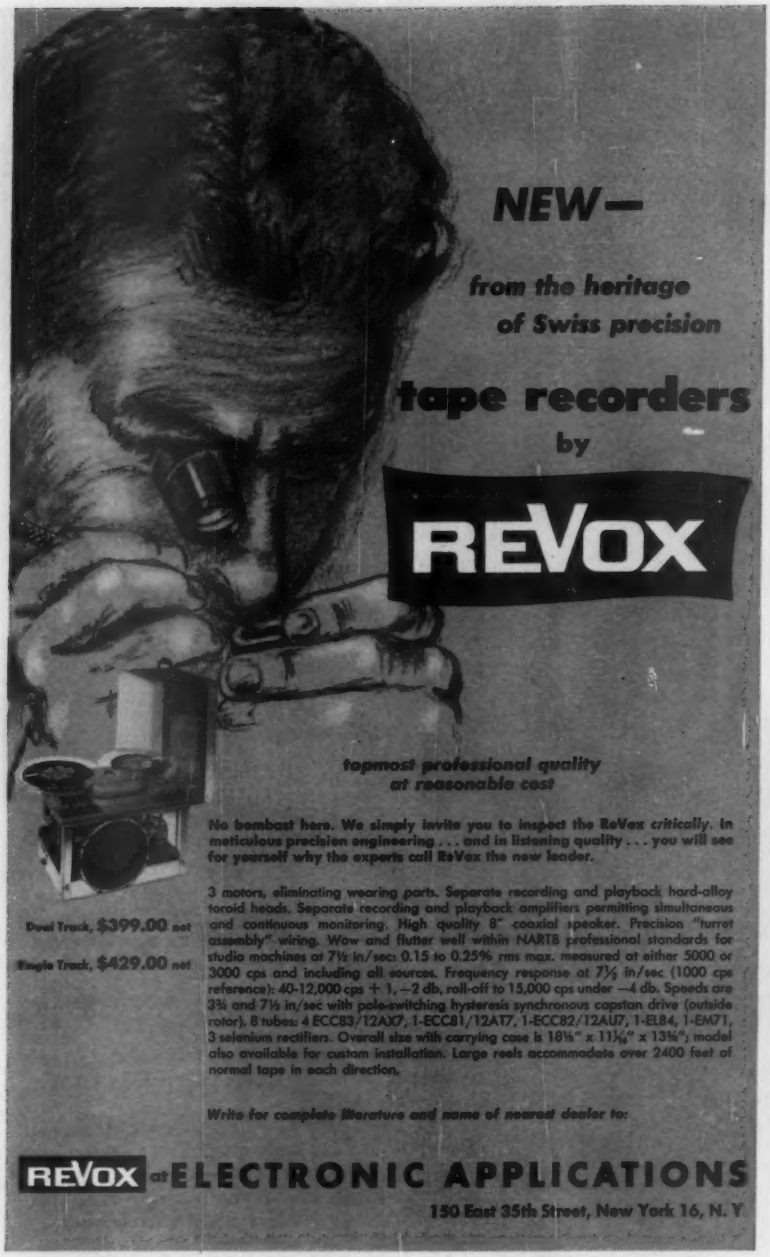
NEW—
from the heritage
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tape recorders
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topmost professional quality
at reasonable cost
No bombast here. We simply invite you to inspect the ReVox critically. In meticulous precision engineering . . . and in listening quality . . . you will see for yourself why the experts call ReVox the new leader.
3 motors, eliminating wearing parts. Separate recording and playback hard-alloy toroid heads. Separate recording and playback amplifiers permitting simultaneous and continuous monitoring. High quality 8" coaxial speaker. Precision "turret assembly" wiring. Wow and flutter well within NARTB professional standards for studio machines at 7½ in/sec: 0.15 to 0.25% rms max. measured at either 5000 or 3000 cps and including all sources. Frequency response at 7½ in/sec (1000 cps reference): 40-12,000 cps + 1, —2 db, roll-off to 15,000 cps under —4 db. Speeds are 3¾ and 7½ in/sec with pole-switching hysteresis synchronous capstan drive (outside rotor). 8 tubes: 4 ECC83/12AX7, 1-ECC81/12AT7, 1-ECC82/12AU7, 1-EL84, 1-EM71, 3 selenium rectifiers. Overall size with carrying case is 18⅛" x 11⅛" x 13⅜"; model also available for custom installation. Large reels accommodate over 2400 feet of normal tape in each direction.
Dual Track, $399.00 net
Single Track, $429.00 net
Write for complete literature and name of nearest dealer to:
REVOX at ELECTRONIC APPLICATIONS
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PROMOTIONAL THEME

"Compare It With *Merit*" will be the theme of *Merit Coil & Transformer Corporation's* advertising and promotional program for the remainder of the year.

Distributors will be urged to check the firm's loose leaf replacement guide against specifications of all TV manufacturers for replacements on all original components, and then to make product comparisons with other lines.

* * *

COUNTER DISPLAY BOX

Vaco Products Company has designed a new, interchangeable tool kit components counter display box.

Designated as No. AZ614, the box is made of heavy cardboard, 18¼" x 9", and 2½" deep. In use, the lid is lifted, opening out into a back display panel 21" wide and 10" high. The complete purpose of the exhibit is told in bold

type on the lid. Also shown is a picture of the kit bag with handle and blades. The entire box is printed in blue and yellow and is divided into 16 separate sections. Each section contains six each of 16 individual components.

Descriptive literature including complete prices will be sent upon request. Inquiries should be directed to the sales manager of the firm, at 317 E. Ontario Street, Chicago 11, Ill.

* * *

NEW SALES KIT

An attractive white, gold, and black sales "case," designed specifically to assist *Snyder Mfg. Co.* distributor and dealer salesmen in selling and merchandising the firm's new "Imperial" TV antenna, is being made available by the company without charge.

The kit is made of sturdy corrugated cardboard and is designed to hold three different decorator color antennas in order to permit the showing of all three simultaneously.

In addition, the special sales cases will come with window streamers, counter displays, catalogues, envelope

GET INTO
ELECTRONICS

Valparaiso Tech trains for top flight positions. Technical representatives, field engineers, sales and specialists in communications, missiles, computers, radar, automation, color television. Basic and advanced theory and laboratory. Major companies visit school for our graduates. 21 months' course. High school graduate or equivalent. Dormitories—campus. Start January, April, July, September. G.I. approved. Write for Catalog.
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REAL BARGAINS IN BEST ELECTRONIC SURPLUS

50 W. 6-CHANNEL RADIOTELEPHONE for BOATS, MOBILE, or FIXED STATIONS

THE BIGGEST BARGAIN IN PLEASURE OR FISHING BOAT RADIOTELEPHONES!!! Big-power ship-to-shore Radiotelephone. This Transmitter-Receiver (BC-669), part of SCR-543) is beautifully and ruggedly built. Designed for rough military service and engineered for maximum efficiency, it will provide trouble-free long-range communications from boat, vehicle, portable or fixed station installations. Both Transmitter and Receiver operate in the frequency range of 1680 to 4450 KC, and both are crystal-controlled on all six channels in this range. Manual tuning of the receiver is also provided. Power Output (Phone) is 50 to 60 watts with 12 V. DC Power Supply.

Transmitter operation is performed with a minimum of controls, after installation adjustments have been made. The BC-669 is presently TYPE ACCEPTED by FCC for marine band use except on 2738 Kc for which frequency a wave trap to eliminate 2nd harmonic radiation must be employed. Operation of DC, 32 V. DC, 24 V. DC, or 12 V. DC. Complete constructional data and diagrams are furnished for building any of the above power supplies at minimum cost. Each set is supplied with 12 crystals (6 for for X-mit, 6 for receive) which were used by the military. Receiving crystals differ by 385 KC (IF frequency). Most of these crystals can be reground to marine band frequencies. Receiver uses high-efficiency 10 Tube Superhet circuit with Variable Selectivity, built-in loudspeaker, Static Filter (Noise Eliminator) Circuit with Switch, and RF Gain Control. Transmitter uses 8 Tubes (2-807's in Final) with 100% Plate Modulation, and Metering Switch with multi-range milliameter for instant checking of any part of transmitting circuit.

50-WATT RADIOTELEPHONE (BC-669A, B, or C Models), complete with all tubes, crystals (as specified), Inst. Book, Connecting Cord CD-515 (to Power Supply), Modification and Power Supply constructional Data. **USED, GOOD CONDITION.** Shp. wt. 185 lbs. **EACH** **$99.50**

SAME AS ABOVE, NEW UNUSED CONDITION .. **$139.50**

MODELS BC-669 D or E. Same as Above, but provides also CW (telegraphy) transmission and reception (incorp. BFO). **NEW, EACH** **$169.50**

TS-11 HANDSET, with appropriate plug connector. **EACH** **$14.50**

CUSTOM BUILT 12 V. DC POWER SUPPLY FOR ABOVE, EACH **$129.00**

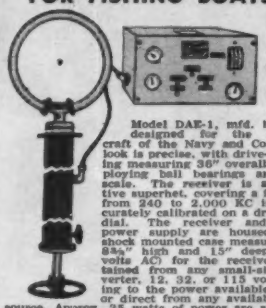
PE-110 A, B, or C, 110 V. AC POWER SUPPLY. EACH **$89.50**

PE-110 D, 110 V. AC POWER SUPPLY. EACH .. **$99.50**

12 V. DC POWER SUPPLY KIT, complete with transmitting and receiving dynamotors, relay, filter capacitors, choke, switches, fuse holders, etc., plus undrilled chassis and wiring diagram. **EACH** **$45.00**

RM-21 REMOTE CONTROL. Permits transmission & reception (by handset) from remote position. **EACH .$6.95**

DE-LUXE DIRECTION FINDER FOR FISHING BOATS, ETC.



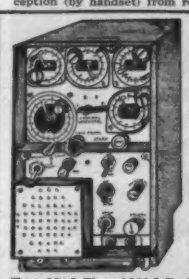
Here's a swell buy for the larger pleasure yacht, or party fishing boat that wants a real, accurate, precision direction finder. Known as the Model DAE-1, mfd. by RCA, it was designed for the smaller patrol craft of the Navy and Coast Guard. The look is precise, with drive-shaft and housing measuring 36" overall in height, employing ball bearings and 5" azimuth scale. The receiver is a highly sensitive superhet, covering a frequency range from 240 to 2,000 KC in 3 bands, accurately calibrated on a drum-type tuning dial. The receiver and 110-volt AC power supply are housed in a rubber shock mounted case measuring 14" wide, 8¾" high and 15" deep. Power (110 volts AC) for the receiver may be obtained from any small-size rotary converter, 12, 32, or 115 volts DC, according to the power available on shipboard, or direct from any available 110 V. AC source. Approx. 35 watts of power are required for the receiver. All units are NEW-UNUSED, include necessary cables, hardware, and small metal case of spare parts and tubes. Also, complete installation and Instruction Book. Shpg. wt. on 2 cases, 200 lbs. **PRICE, EACH, as described** **$139.50**

NEW, WALKY-TALKY (BC-611) CHASSIS

Here's the chance to build your own real compact, lightweight hand-held Walky-Talky! Designed to transmit and receive on one (crystal-controlled) frequency between 3.5 and 6.0 mc., any real Ham could revamp the coils for operation on higher frequency amateur phone bands. This will result in increased antenna power output and longer distance transmission. By building your own case for this chassis, with space for larger batteries and increased B voltage, further increased power and longer service from batteries will result. These chassis are NEW, unused, complete with telescoping antenna but less tubes, coils, or crystal. Tubes required: 1—1R5, 1—1S5, 1—1T4, and 2—3S4, 2 miniature plug-in coils required (sold separately), 1—Antenna, and 1—RF Tank. Battery voltages required (original) 1—1.5 volt "A" and 103.5 volts "B" battery, the latter may be increased to 133 or 167.5 volts to produce higher transmitter output. Supplied as specified with Schematic diagram. Shpg. wt. 10 lbs. **EACH**—Chassis only **$12.95**

PAIR OF COILS, for above, Ant. & RF Tank **$1.25**

Mobile FM Receiver BC-923



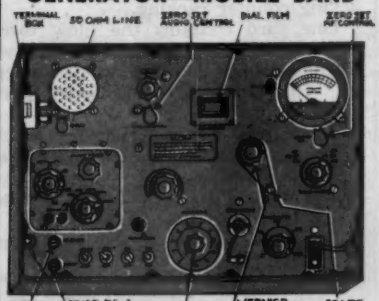
This is a "honey" in receivers, for hams, police cars, firemen, and roving photographers who want to get there first for prize photos. It's complete with built-in loudspeaker, squelch control, speaker-phone switch, sensitivity control, variable (permeability) tuning for each channel of 4 channels (permits presetting of 4 frequencies covering a range of 27.0 to 38.9 mc. By taking a half-turn off each coil winding, range can be extended to 42 or 43 mc. Operates from 12 V. DC and includes dynamotor. Schematic diagram on bottom of each case. Dim.: 11⅛" H. x 6¾" W. x 12⅛" D. Shpg. wt. 60 lbs. **NEW UNITS TESTED** **$49.50**

USED, GOOD, NOT TESTED **$34.50**

MULTI-PURPOSE WALKY-TALKY TESTER

Test Unit I-135, designed to thoroughly test the hand-held Walky-Talky BC-611, is so versatile that it is worthy of acceptance in any radio shop or lab. This unit is a multi-range voltmeter and milliammeter, a crystal tester, and an RF and AF signal source. It will measure battery voltage and current, RF amplifier plate current, audio output voltage, and crystal activity. Incorporates transmitter and receiver elements, as used in the BC-611. Large scale square Volt-milliammeter, an RF Pierce Oscillator, a 1,000 cps Colpitts Audio Oscillator, and a Master Selector Switch which permits selection of the many features of this unit. All housed in portable carrying case (metal) dim.: 14" L. x 9" D. x 5¼" high. Shpg. wt. 35 lbs. USED-Exc. (almost new), supplied with schematic. **PRICE, EACH** **$17.95**

HI-PRECISION FM SIGNAL GENERATOR—MOBILE BAND



Model I-208, is a precision instrument worthy of the finest lab, mobile service and installation shop, or for production testing of mobile FM equipment. Previously it was a scarce and expensive instrument, until we made a fortunate "buy" in a limited quantity. Freq. Range in 2 bands, 1.9 to 4.5 mc (for IF alignment and tests) and 19 to 45 mc. Freq. of output of signal is maintained within .03% of dial calibration over a temperature range from 0 to 60 degrees. Other outstanding features are: •Variable Frequency Deviation, 0-5 KC on 1.9 to 4.5 mc band, 0-50 KC each side of resting frequency on 19 to 45 mc band. •Calibrated Microvolter-Attenuator, adjustable up to 100,000 microvolts, developed at the termination of a 30-ohm line. Up to .84 volt available at high output terminals. •RF Vacuum Tube Voltmeter incorporated, tion frequencies provided by internal audio oscillator, 150, 400, 1,000, 2,500, and 5,000 cps. External modulation also provided for. •Operates from either 110 volts, 50 cycles AC, or 12 volts DC which is ideal for in the field work. •Crystal Calibrator, whose output is 1 mc and harmonics for checking and maintaining accuracy of signal generator. Each I-208 is supplied complete with tubes, calibrator crystal, 12V. DC Dynamotor and 110V. AV power supply are self-contained, Instruction Sheets and Schematic Diagram. Shpg. wt. is 175 lbs. (in wooden case). Av.ilable in NEW-Unused (tested) or Used-Excellent (tested) condition. Act fast, our limited supply won't last long!!

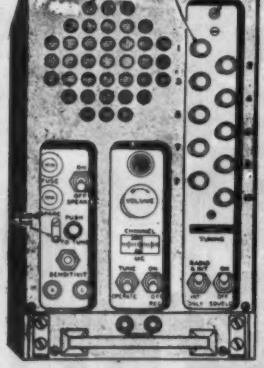
USED, EXCELLENT ..... **EACH $89.95**

NEW, UNUSED ..... **EACH $139.50**

All Above Material Subject to Prior Sale. 25% Minimum Deposit with All C.O.D.'s. All Prices F.O.B. Our Address.

Inquiries invited from Exporters, Governmental Agencies and Industrial Companies. We have a large selection of communications equipment and specialized electronic material.

BC-683 MOBILE FM RECEIVER



Similar to BC-923 described above in frequency range and physical appearance, but provides 10 push-button selected channels as well as continuous variable tuning over the entire range of 27.0 to 39.0 mc. Includes features such as: built-in loudspeaker, squelch circuit, A.V.C., double limiter circuits, headphone jacks, sensitivity control, accurate calibrated tuning dial, etc. Supplied complete with 12V. DC Dynamotor for 12-volt operation, all tubes, and schematic diagram which is glued to bottom of mounting case. Shpg. wt. 65 lbs. **PRICE, EACH,** Used - Excellent Condition. Not TESTED **$35.95**

PRICE, EACH, NEW-TESTED **$45.95**

RF POWER TESTER FOR LOW-POWER WALKY-TALKIES

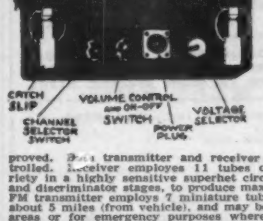
Designed to tune-up Hand-Held Walky-Talkies to best operating efficiency, this instrument can be employed by Hams, technicians, and laboratories to perform many useful functions. Employs a 50 ma. RF meter, receive-transmitter switch, a 56-ohm non-inductive resistor, and a variable capacitor of 8 mmf. maximum. By removing resistor and substituting a few-turn pickup coil, a device is made for coupling to low power oscillator or RF stages of a transmitter to determine relative efficiency or operation—instead of the old-fashioned lamp-indicator absorption meter usually employed. The sensitive RF meter in this unit permits many other versatile applications, and is worth the price we ask for it. All NEW-UNUSED condition. Shpg. wt. 10 lbs. Limited Quantity Available! **EACH** **$15.95**

LORAN RECEIVING EQPT., APN-4, AT LOWEST PRICE EVER!!!

We made a "buy" on this popular model APN-4 Loran unit, used on Fishing and Pleasure boats and Aircraft for navigational purposes. All are Used but in **Very Clean** condition, complete with tubes and crystals. Each set consists of an R9/APN-4 Receiver and an ID-6/APN-4 Indicator. Originally sold in surplus for $100.00 or more per set, it would be wise to buy an extra set for "Spare" while available at this real low price! Sorry, no accessories or inverter (80 to 115 V. AC, 400 to 2400 cycles, required) available at this time. Inverters for this equip. are available from many surplus houses. **PRICE PER SET,** each consisting of one Indicator and one Receiver, as above. Not Tested. **$29.95**

Excellent—Used. Shpg. wt. 80 lbs. .....

2-CHANNEL FM TRANSCEIVER 30-39 MC.



The BC-1335 is an 18-tube lo-power (1.5 watts) transmitter and receiver for FM. Ideal for mobile installations, operating from either 6 or 12 volts DC (self-contained power supply), especially for receiver monitoring of fire or police calls; transmitter would have to be FCC type approved. Both transmitter and receiver are crystal-controlled. Receiver employes 11 tubes of miniature variety in a highly sensitive superhet circuit with limiter and discriminator stages, to produce maximum reception. FM transmitter employs 7 miniature tubes. Its range is about 5 miles (from vehicle), and may be used in remote areas or for emergency purposes where FCC approved. However, at the price we are asking, and considering the compactness of this transceiver (11⅛" L. x 10⅛" D. x 6¼" H.) it's a swell buy just to use the receiver section only. All in Used-Exc. cond., compl. with tubes, and schematic diagram. Not tested, at price quoted. Shpg. wt. 45 lbs. **PRICE, EACH,** as described **$34.95**

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A BOX IS NOT A MUSICAL INSTRUMENT

No skilled musical instrument maker, including even those in aboriginal tribes, has ever found a rectangular box satisfactory. **IN SPITE OF THIS,** today many HI-FI speaker systems proclaim the ultimate in high fidelity, yet they employ nothing more than the most elementary boxes to perform the complicated function of transforming the vibrations of the loudspeaker into sound.

In the **KARLSON ENCLOSURES,** specially curved internal and external structures are used to provide you with the highest performance capabilities available in the industry today. Actually the Karlson enclosure is one of the most fabulous musical instruments ever created and is capable of reproducing every sound from a baby's breath to the mighty roar of thunder. After long and rigorous tests, we know definitely that the Karlson Enclosures can outperform all other units now available on the market at any price.

Despite their fantastic performance characteristics these units are available to you in 20 different models in **KIT, UNFINISHED AND FINISHED FORMS,** at prices you can afford, ranging from $18.60 to $174.00.

SEND FOR OUR COMPLETE CATALOG TODAY AND LEARN HOW THE KARLSON ENCLOSURE CAN BE FITTED TO YOUR SPECIFIC NEEDS.

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There's always something new being developed by Perma-Power

stuffers, and other merchandising aids.

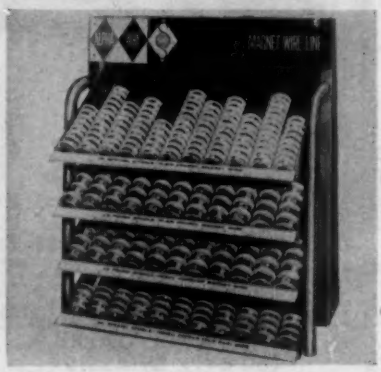
The kit measures 18" x 28" and can double as a window or counter display.

* * *

SELF-SERVICE DISPLAY

Alpha Wire Corporation has now modernized the sale of its wire with a new self-service counter display.

The display unit measures 38" high,



27¾" wide, and 12" deep. It serves to sell the 44 most widely used magnet wire items on two sizes of handy metal "service spools" and is designed to boost impulse buying since there is no need for respooling or sales talks.

* * *

"SKINPACK" DISPLAY

Kidde Manufacturing Company, Inc. has made available to the professional and hobbyist alike two new transparent plastic covered cards which hold a small, inexpensive blow torch. These "skinpack" displays give full view of the torch and permit space-saving counter racking.

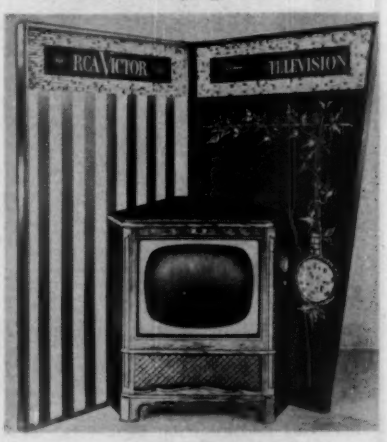
One card contains the blow torch and cartridge, while the second comes equipped with the blow torch, soldering tip, solder, and two chargers.

* * *

TV SALES THEME

RCA Victor has completed plans for an extensive advertising display for its new space-saving line of black-and-white television receivers.

The entire campaign is built around



the theme, "Lean, Clean, and Mirror-Sharp," and will feature an attractive high-fashion model demonstrating the reduced cabinet depth of the new sets.

WE TRADE HIGHER!

Howdoody...

I'm Jack S., head eevaluator of trade-ins at the Walter Ashe Radio Co. Now, I don't eevaluate heads! So don't go sendin' in no shrunken, head-hunters handiwork, 'spectin' cash allowance on new merchandise. What I mean is....I'm in charge of the Dept.

The picture shows me gettin' down to the office bright and early....well, early! My chauffeur drives me down in a long white limousine, with an assistant chauffeur at his side. They both help me off with my coat....it's a little tricky....and stand at attention while I eevaluate old store-bought eelectronic stuff people want to trade in on fine new merchandise. (Nothin' older than 1945.)

The Boss says I'm doin' a bang-up job! My department took a whoppin' loss last month.....which is the way the Boss wants it. He fired my predesse....predicess....predasess...the guy what had the job before me for showing a $1.89 profit in a three-month period. Heck, my salary alone loses him that much in a day's time! He says I got real job security if I can stay as moronic as I am!

Write when you get work, or when you decide to trade!

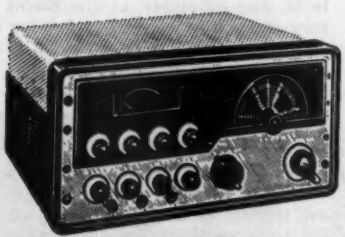
Jack S.

IT'S EASY TO DO BUSINESS WITH WALTER ASHE!

1. Just tell us what factory-built gear (made since 1945) you have to trade, and what new gear you wish to purchase. You'll get our top dollar quote by return mail.

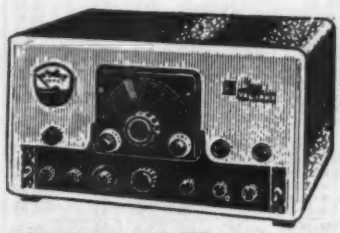
2. When the deal is made, you ship your equipment to us by prepaid express or, if express is not available, by prepaid truck. We check it at once and, in most cases, your new gear is on its way to you within 24 hours after we receive your trade-in.

3. We will ship your new gear to you via express in most instances. Where express is not available, or not practical, we will ship by truck.



HALLICRAFTERS HT-32 TRANSMITTER. Net.....$675.00

HAMMARLUND HQ-110. Less Clock. Net.....$ 229.00



JOHNSON VALIANT KIT. Net..$ 349.50
Wired..... 439.50

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☐ Rush "Surprise" Trade-In Offer on my.....
for.....
(show make and model of new equipment desired)

RN-10-57

☐ Send new FREE Walter Ashe catalog.

Name.....
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City.....Zone.....State.....

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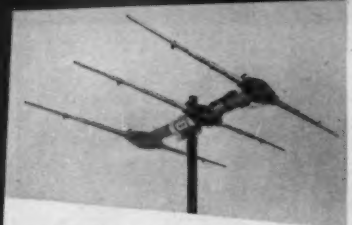
TELREX '56

Beam Antennas



Commercial grade arrays at amateur prices; superior in performance, design and construction to any other antenna. Hair-pin resonated, precision tuned, matched and calibrated. Provide highest signal-to-noise ratio possible; 75% reduction in precipitition static.

FEATURES

- Extremely rugged elements of advanced sectional design; taper-swaged to reduce useless wind drag and silhouette by 55%.
- Special sturdy molded element support made of Borg-Warner "Cycolac", a very high impact thermoplastic resin; holds, insulates and capacity-couples element to the boom for automatic dissipation of precipitation static.
- Stainless-steel airplane-type clamp, holds element sections firmly in exact position.
- Precisely constructed and the famous Telrex "Balun" help produce outstanding performance per element, clean-cut balanced pattern and minimum TVI.
- Single, heavy-wall aluminum boom is small in size, rugged in strength, and light in weight.
- Stainless steel "Hairpin" grounding lug provides element grounding at voltage node for lightning protection

"SERIES 56" SPECIFICATIONS AND PRICES

Telrex No.	Meter Band	Elements No.	Gain db	Shpg. Wt. Lbs.	Amateur Net Each
¾M-15C	¾	15	16 2	13	$ 29.00
1¼M-5C	1¼	5	11.0	3	6.95
1¼M-15C	1¼	15	16.2	16½	31.00
2M-3C	2	3	9.4	2¾	5.95
2M-5C	2	5	10.5	5	7.25
2M-6C	2	6	12.7	4	12.50
2M-8C	2	8	13.5	10	13.75
2M-8SD‡	2	16	10.5	15	33.50
2M-15C	2	15	16.2	28	39.25
6M-3D	6	3	9.4	7	16.25
6M-4C	6	4	9.7	10	19.75
6M-6C	6	6	12.7	20	57.50
6M-6S-13S§	6	6	12 7	44	149.00
10SD-S	10	3	7.0	9	26.50
10M-6S-7S†	10	3	8.9	27	96.00
10M-6S-12S‡	10	4	10 1	33½	144.00
10M-6S-18S§	10	5	11.2	77	220.00
10M-6S-23S§	10	6	12.7	93	290.00
15M-6S-6T‡	15	3	4.8	22	80.00
15M-6S-9S†	15	3	8.9	32	117.00
15M-6S-11S‡	15	4	9.7	37	140.00
15M-6S-19S§	15	4	11.1	64	235.00
15M-6S-24S§	15	5	11.9	94	285.00
20M-6S-7S	20	2	4.9	26	80.00
20M-6S-11S‡	20	3	8.7	33	130.00
20M-6S-14S§	20	3	9.0	56	175.00
20M-6S-16S§	20	3	9.4	65	198.00
20M-6S-23S§	20	4	10.4	74	275.00
20M-6S-26S§	20	4	11.2	99	305.00
40M-6S-18S	40	2	3.4	65	180.00
40M-6S-30S§	40	3	8 3	130	365.00

†Circular polarized ‡Deluxe Model §Super Deluxe Model

Harvey has in stock the New Tri-Band Antennas for 10-15-20 Meters

MAIL ORDERS SHIPPED SAME DAY AS RECEIVED

Include with payment an allowance for shipping charges. Prices subject to change without notice.

HARVEY RADIO CO., INC. Estab. 1927

1123 Avenue of the Americas (6th Ave. at 43rd St.) N.Y. 36, N.Y. JU 2-1500

The advertisements will call attention to such features as newly styled cabinets that fit close to walls, console models that fit perfectly into corners, etc. The company also plans on heavy use of network and local radio and TV commercials, billboards, and local newspaper ads. In addition, a complete new mat book is being supplied to all distributors to aid them in placing newspaper advertising.

One of the featured sales promotion items is a new 16-page brochure which contains full color photographs of all 29 new black-and-white and 11 current color television receivers. Two full-color mailers—one for fall and the other for Christmas—also have been announced.

Other new promotional material includes banners, wall charts, on-set feature cards, special background displays for "custom corner" television sets, and outdoor signs.

* * *

RECOTON "CLUB"

In order to promote the sale of its products, *Recoton Corp.* has inaugurated a "Deals-of-the-Year Club."

The company will work out special buys for customers, featuring fast-moving items only. As a "Club" member, the distributor will receive valuable cash prize certificates which are to be filled out and returned to the firm. These certificates are redeemable until December 31, 1959.

Membership cards and complete details may be obtained from the company's sales manager, 52-35 Barnett Ave., Long Island City 4, N. Y. —30—

IMPROVING "MARK II" DYNAKIT

UP to the present time, all of the power amplifier kits produced by Dyna Company were designed with the cathodes of both EL34 output tubes connected to ground.

Recent reports from the company show that the intermodulation and harmonic distortion can be reduced substantially by adding a precision 12-ohm, 1-watt ±1% wirewound resistor from the cathodes of both EL34's to ground.

This, in essence, adds a self-biasing effect to the original fixed biasing circuit. Since the resistor is unbypassed, it produces a current feedback. Any unbalance in drive signal or in the dynamic tube characteristics of the output stage causes a signal component to appear across the resistor. This signal, which constitutes negative feedback, reduces both IM and harmonic distortion.

Proper grid bias adjustment can now be simplified. Just adjust the bias control until a d.c. voltage of 1.56 volts is obtained across the 12-ohm resistor. Optimum bias is obtained in this manner even though the grid voltage on the EL34's may measure anywhere from −35 to −42 volts. —30—

Two-Meter Amplifier

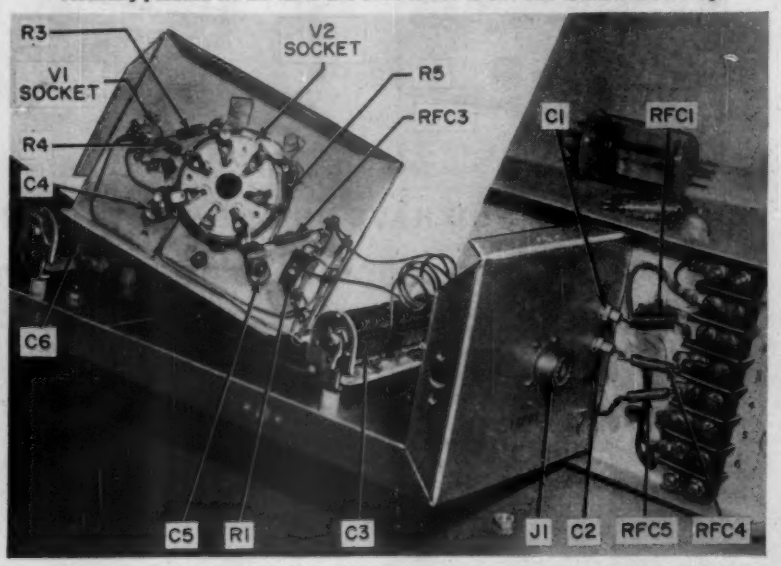
(*Continued from page* 71)

itor and output coupling are interactive and will have to be see-sawed for best results. Maximum power out will not coincide exactly with the plate current dip. Best efficiency occurred when tuning the plate circuit for maximum output power. This is more or less typical of almost all v.h.f. amplifiers.

Maximum driving voltage was obtained at maximum coupling of the grid and input coupling coil. This was when the two grid coils and input coupling coil employed a common axis.

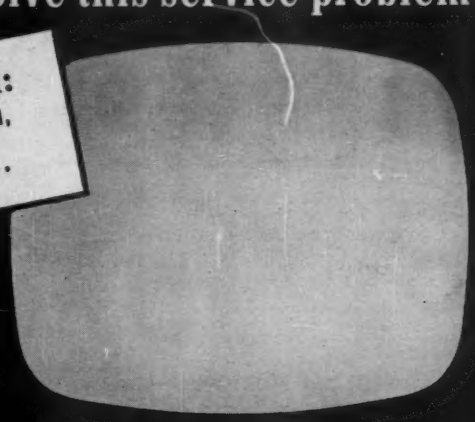
A final test on the stability of this amplifier is to remove drive and the output loading. Plate current should not flicker as grid and plate tuning capacitors are rotated through all possible settings. Under these severe tests, the amplifier at the *Gates* factory showed no sign of parasitics even with the shield cover removed. —30—

Mounting partition for the tubes has been turned to one side to show the wiring.



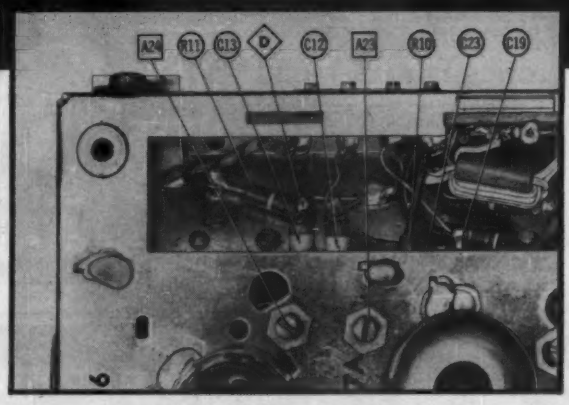
how long would it take you to solve this service problem?

SYMPTOM:
Raster, No Sound,
No Picture,
and No Snow...



PHOTOFACT

helps you lick problems
like this in just minutes
for only *2½¢ per model!



(Based on an actual case history taken from the Howard W. Sams book "TV Servicing Guide")

Let's take a look at this problem: A condition such as this can exist only when there is no signal reaching the picture tube or the audio output stage. Using the Tuner Service data (found in every PHOTOFACT TV Folder), first isolate the trouble by connecting an amplitude-modulated signal to the mixer-grid test point "D." The appearance of one or more black bars on the face of the tube would indicate that the trouble is probably in the tuner. So look for the following possible causes:

1. Defective oscillator-mixer tube
2. Defective RF amplifier tube
3. Open plate-load resistor in the oscillator stage
4. Failure of the feedback capacitor in the oscillator stage
5. Open decoupling resistor
6. Dirty or faulty contacts
7. Cold solder joint

Using the applicable PHOTOFACT Folder you can trouble-shoot and solve this problem in minutes. Here's how:

Check the oscillator-mixer and RF amplifier tubes. Tubes okay?—then: Check voltages on the tube pins (they're right on the schematic) for open oscillator plate-load resistor, open RF decoupling resistor, faulty feedback capacitor, dirty switch contacts or cold solder joints.

Every PHOTOFACT Television Folder contains complete detailed information on Tuners, including separate Schematics, separate Keyed Chassis Photographs, Parts Lists, Alignment Points, Test Points, and Field Service Adjustments that will help you quickly locate the proper parts to replace and tell you how to do a touchup or thorough alignment job after making the necessary repairs. These features are a *plus* exclusive in PHOTOFACT.

Whatever your problem or favorite servicing procedure may be—you will always find all of the information you need at your fingertips in PHOTOFACT. For only *2½c per model, PHOTOFACT helps you solve your service problems in just minutes—helps you service more sets and earn more daily!

*Based on the average number of models covered in a single set of PHOTOFACT Folders.

MONEY BACK GUARANTEE!

Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper PHOTOFACT Folder Set covering the receiver. Then use it on the actual repair. If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. GET THE PROOF FOR YOURSELF—TRY PHOTOFACT NOW!

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Fill out and mail coupon today for Free subscription to the Sams Photofact Index—your up-to-date guide to virtually any receiver model ever to come into your shop. Send coupon now.

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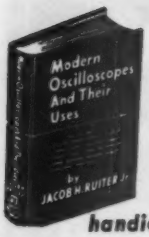
City_____ Zone____ State_____

22 TUBE ECDFX FM-AM HI-FI TUNER-AMPLIFIER SALE $99.95



GET MORE WORK OUT OF YOUR OSCILLOSCOPE

Learn to service ANY radio or TV faster . . . with the handiest instrument of all!

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Clearly as A-B-C, MODERN OSCILLOSCOPES AND THEIR USES tells you exactly when, where and how. You learn to locate either AM or FM radio or television troubles in a jiffy. Even tough realignment jobs are made easy. No involved mathematics! Every detail is clearly explained—from making connections to adjusting circuit components and setting the oscilloscope controls. And you learn to analyze patterns fast and RIGHT!

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Includes Color TV 'Scope Data

Includes latest data on use of 'scopes in color TV, industrial electronics, teaching . . . even in atomic energy work. Over 400 pages and over 400 clear pictures. Dozens of pattern photos make things doubly clear . . . even for beginners!

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Give You
110 A.C. HOUSE CURRENT ANYWHERE
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For 6 and 12 Volt Car Batteries. Output Rating 90 to 125 Watts

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PORTABLE TV

NO INSTALLATION

Just plug into cigar lighter on dash of car, truck, or boat—and away we go

- OPERATE PORTABLE TV,
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One of the great conveniences of our electronic age

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101 USES

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DO-IT-YOURSELF HOBBY TOOLS

SEE YOUR ELECTRONIC PARTS DEALER OR JOBBER

TERADO COMPANY

DESIGNERS & MFRS OF ELECTRONIC EQUIPMENT SINCE 1927

1058 RAYMOND AVE., ST. PAUL 14, MINNESOTA

ASSEMBLE YOUR OWN

WALKIE-TALKIE RADIOPHONES

for as little as **$6.98** plus accessories

Specifications: Tunes 144-148 mc. 1 to 5 mile range (depending on terrain) with 18 inch antenna and much more with directional beam antenna. Variable frequency transceiver circuit. High level amplitude modulation. Silver plated tank circuit and many other exclusive features assure maximum efficiency and long battery life. Fully portable—no external connections ever needed. Meets FCC requirements for general class amateur license. No minimum age requirement.

The following components are all you need to assemble a complete walkie-talkie as illustrated:

Factory wired and tested transceiver chassis complete with VHF dual tube	$6.98
High output carbon mike	1.49
Miniature mike transformer	.98
Powerful alnico magnet headphone	1.25
Strong 16 gauge aluminum case (7"x5"x3") with all holes punched, battery compartment, battery switch plus all hardware and fittings including 18" antenna	3.98
Case finished in gray hammertone if desired	.75

for as little as **$14.98** plus accessories

Specifications: Tunes 50 to 54 mc. 1 to 5 mile range (depending on terrain) with 24" antenna and much more with directional beam antenna. Crystal controlled transmitter and variable frequency receiver with R.F. stage. Silver plated coils, highest quality components and exclusive design assure maximum efficiency and long battery life. Fully portable—no external connections ever needed. Meets FCC requirements for technician and general class amateur license as well as civil defense and other special services. Available also on neighboring frequencies at slight extra cost.

The following components are all you need to assemble a complete walkie-talkie as illustrated:

Factory wired and tested transmitter-receiver chassis complete with all tubes	$14.98
Very active quartz transmitting crystal ground to .01% of your desired frequency and hermetically sealed	3.98
Western Electric communication type telephone handset with push-to-talk switch and standard cord	6.98
Coiled spring cord if desired	1.00
Handset input transformer	.98
Handset output transformer	.98
Strong 16 gauge aluminum case (8" x 5" x 3") with all holes punched, battery compartment, battery switch, telephone handset cradle plus all hardware and fittings including 24" antenna and loading coil	4.98
Case finished in gray hammertone if desired	.75
Adjustable shoulder strap (not shown) if desired	.50

Both models use standard batteries available at your local radio store. All components guaranteed for one year against defects in manufacture.

HOW TO ORDER DIRECT FROM FACTORY:

Check each item desired and add 5% of total for postage and insurance.
Orders not paid in full will be sent C.O.D. for the balance due.
All C.O.D. orders must include $2.00 deposit.

MAIL TO:

All orders immediately acknowledged.

SPRINGFIELD ENTERPRISES
Manufacturing Division
Box 54-R10, Springfield Gardens 13, N. Y.

The detector is small, compact, and it can be easily carried in pocket or purse.

Radiation Detector For Home Use

Small, light, and inexpensive unit designed for emergencies.

THE Gamma Atomic Radiation Detector, or GARD as it is known by its manufacturer, *Sargent - Rayment Co.*, is a simple detector for determining the presence of harmful radioactive fallout resulting from the aftermath of a nuclear explosion. It is to be used principally as a home survey meter by a family under emergency conditions of nuclear warfare, or accidental contamination.

The radiation detector uses no tubes, meters, or batteries, or any moving parts that will wear out, or any parts that discharge or need charging. It may be stored and still be ready for use or reuse at any time.

GARD works on the principle of gamma sensitive crystals that glow at various intensities of gamma radiation. These crystals are easily viewed through the magnifying lens when the unit is held to the eye. The user will always see one tiny illuminated rectangle which is of luminous material and acts as a comparison standard. If two small rectangles of light are visible, then the user is in a radioactive field of medium intensity. The tolerable exposure here would range from 3 to 20 hours. If three small rectangles of light are visible, then the user is in a dangerously radioactive area.

The detector employs cesium iodide or cadmium tungstate crystals which do not wear out. The unit is sensitive to gamma fluxes in the range from a few to a few hundred roentgen per hour.

In addition to extensive laboratory testing, unofficial field tests were performed at the Nevada Proving Grounds, with very satisfactory results. Untrained, non-scientific personnel, using test units, readily detected varying fields of radioactive fallout.

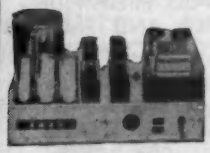
GARD weighs only 2 ounces and its maximum outside physical dimensions are 2"x1½"x1". —30—

22 TUBE ESPEY FM-AM HI-FI TUNER-AMPLIFIER

SALE PRICE $99.95

A REGULAR $199.50 NET VALUE COMBINATION FOR $99.95

FM/AM TUNER
ESPEY 14-TUBE MODEL 700G



ESPEY 24 WATT
MODEL 501G AMPLIFIER

MODEL 700G FM-AM TUNER AND MODEL 501G AMPLIFIER

SPECIAL SALE PRICE BOTH FOR **$99.95**

ATTRACTIVE LEATHERETTE TUNER CABINET $7.95 EXTRA

McGee offers you both the regular $119.50, 14 tube Deluxe FM-AM tuner and the regular $79.50, 8 tube audio amplifier for the special sale price of only $99.95. The Model 700G Espey tuner has its own built in power supply. Performance features are: Sensitivity 3mv on AM, 5 mv on FM for 30 db quieting. AM selectivity 10kc at 6 db. FM 240 kc at 6db. Audio response flat from 20 cps to 20,000 cps., with less than ¼ percent distortion with one volt audio output. Chassis is 14" long, 8½" high and 10" deep. Features a one-piece molded, gold color plastic front which makes a custom installation both extremely attractive and easy at the same time. Full tuned RF stages-AFC on FM with defeating switch for easy FM tuning. Built-in preamplifier for GE or other popular variable reluctance cartridges. Three position equalizer switch for LP, AES or European records. Separate bass and treble tone controls with 23db boost. Chassis is equipped with AC outlet jacks, auxiliary input jacks for tape recorder, etc. Has built-in ferrite loop antenna for AM broadcast band and 300 ohm input for FM band. This fine quality FM-AM tuner is second to none. It has all of the features that you might expect of a tuner that would cost as much as $200. All of the controls are on the front panel. This is a most desirable feature when the tuner is used in conjunction with a good audio amplifier, such as the 501G which was designed with no tone control or preamplifier circuits.

The model 501G, 8 tube ultra-linear high fidelity, 24 watt audio amplifier is made to match the 700G tuner. This amplifier features less than ½ percent distortion with high fidelity response from 10 cps. to 20,000 cps. Hum level so low it can be detected by electrical instruments only. Chassis size, 12"x5"x8". Output tubes: 4—6V6GT in push-pull Williamson circuit. 6SN7GT phase inverter and 2—5V4G rectifiers. Has an 8 pound potted case output transformer with specially made grain-oriented iron core. Output impedance taps of 4, 8 and 16 ohms. This output transformer alone is a $20.00 value.

Buy both the 700G FM-AM tuner and the matching 501G amplifier for only $99.95. Tuner shipping weight 20 lbs. Amplifier shipping wt. 22 lbs. See the special deals of the 700G-501G tuner-amplifier combination with record changer and GE cartridges for extra money saving values. Also, special discount on speakers and speaker systems when ordered with your Espey tuner and amplifier.

ESPEY DEAL—1A

Espey 700G-501G tuner with 24 watt amplifier plus VM-935 GE 3 speed VM on metal base—1 Mill Diamond GE Needle $10.00 extra. Net **$124.95**

ESPEY DEAL—2

Espey 700G-501G tuner with 24 watt amplifier plus new 456 Collaro changer equipped with a GE RPX-052A cartridge. Net **$144.95**

ESPEY DEAL—3

Espey 700G-501G tuner with 24 watt amplifier plus Garrard RC-99 equipped with a GE RPX-052A cartridge. Net **$174.95**

SPEAKERS RECOMMENDED

Order any of the following speakers with your Espey tuner and amplifier:
12" coaxial PM, CU-14Y—$30.00 extra
15" coaxial PM, P15-CR—$30.00 extra
Imperial IV system—$15.00.
Imperial VI system—$25.00.
Norelco 9762—12" regularly $59.50 at $30.00 extra.
EV84—15W system—$150.00 extra.

11-TUBE FM-AM HALLICRAFTERS

HALLICRAFTERS S-78A

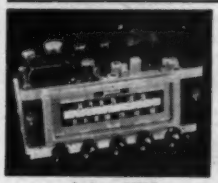
REGULAR $89.50 VALUE!

SALE PRICE **$49.95**

WITH MONARCH 4-SPEED RECORD CHANGER, 12" COAX. SPEAKER

$132.40 VALUE ALL FOR **$86.95**

Now, buy a complete FM-AM chassis with push-pull audio built-in, at less than you would pay for a tuner without audio amplification. We offer you this nationally known Hallicrafter S-78A, 11 tube FM-AM radio chassis complete with escutcheon plate and knobs, to be put in your own cabinet or mounted in your recreation room wall. Features a 11 tube power transformer operated superhet circuit with automatic frequency control on FM, push-pull 6K6 audio gives up to 12 watts peak output with response to 15,000 cps. Use with a good Hi-Fi PM speaker or speaker system. Output matches 3.2 or 8 ohms. Full bass boost tone control. Chassis size: 7¼"x12½" long and 11" front to back. Input for record changer with crystal cartridge. (Self powered pre-amplifier for G.E. variable reluctance cartridge available at $2.95 extra). Model S-78A, 11 tube FM-AM chassis. Ship. wt. 22 lbs. Sale price, $49.95.
S-78A chassis with our CU-14Y, 12" coaxial PM speaker, both for $59.95.
S-78A chassis with our P15-CR, 15" coaxial PM speaker, both for $60.95.
S-78A with CU-14Y and UA8-H, 4 speed Monarch record changer with flip-over crystal cartridge, all for $95.95.
S-78A with CU-14Y and RC-88, 4 speed Garrard record changer with flip-over crystal cartridge, all for $115.95.



Jackson AM9A

9-TUBE HI-FIDELITY

12 Watts Audio
Dual Tone Controls

$29.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

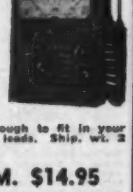
Jackson AM9A, 12 watt hi-fi audio amplifier and broadcast tuner combined. Less than you would pay for the amp alone. Push-pull 6V6's. Response 30 to 15,000 cps. Inputs for crystal or v.r. phono and crystal or dynamic mike. Separate bass boost and treble tone controls, radio-phono switch. Shielded output matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power trans. 9½" illuminated slide rule dial. 3 gang condenser with tuned R.F. and loop ant. Receives 550 to 1650 kc. Size, 13" x 9½" x 8" high. With tubes: 2—6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2—6V6 and 5Y3. Knobs, escutcheon, diagram and instructions included. Model AM9A. Ship. wt. 19 lbs. Sale price, $29.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

9 TUBE—12 WATT HI-FI 8" PM—LEATHERETTE CAB. $44.95

9 tube high fidelity AM9A chassis shown above in leatherette covered cabinet with 8", 6.8 oz. PM speaker having tweeter cone in the center of large cone. Tan leatherette covered cabinet 10"x10"x24" long. Plastic grill cloth covers entire front. Stock No. CAB-98. Ship. wt. 28 lbs. Sale price, $44.95.

2000 OHMS PER VOLT **V. O. M.** $9.95

20,000 OHMS PER VOLT **V. O. M.** $14.95



New, Small volt-ohm-meter 5¼" tall, 3¼" wide and 1½" thick. 3¼" meter. Sensitivity 2000 ohms per volt. DC volts 0 to 1000 in 5 ranges; DC current 0 to 500 ma. in 3 ranges; Resistance 0 to 1.5 megohms in 2 ranges; Decibels minus 20 to plus 16 (0db .774 volts). A thin compact instrument small enough to fit in your service kit. A fine imported meter Model TP-5 complete with test leads. Ship. wt. 2 lbs. $9.95 ea., 2 for $19.50, 4 for $37.00.

NEW 20,000 OHMS PER VOLT V.O.M. $14.95

New model 20,000 ohms per volt volt-ohm meter. Features a 50 micro-amp jeweled meter movement. Small compact size, 3¼" wide, 5¼" long, 1½" thick. 18 position selector switch for 5 AC and DC voltage ranges to 1000 volts. 4 current ranges and 4 resistance ranges to 10 megohms. Price includes test leads and batteries. A $29.95 serviceman value at McGee for only $14.95. Now own 2 meters at a price you might pay for one. A precision instrument. Stock No. TP-5H, $14.95 ea., 2 for $29.00.

McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y

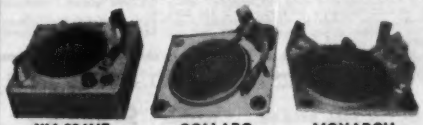
$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheaper speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.

Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 3" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR. McGee's Sale Price, $23.95.

McGee's new 15" Junior coaxial PM speaker. 15" woofer has 6.8 oz. Alnico V magnet. 3" coaxially suspended tweeter with crossover. Only two wires to connect to any 8 ohm radio or amplifier. Frequency response from 40 to 15,000 cps. Model No. MIS-CR, 15" Junior coax PM speaker, Sale price, $16.98.

VM HI-FI CHANGER. SALE PRICE $29.95 LESS BASE LESS CART.



VM-936HF $32.95 | COLLARO 456 - $34.50 | MONARCH UA8H $27.95

$45.90 WITH GE RPX-052A

4 Speed Monarch

SALE PRICE **$27.95**

with 222 Ronette Ceramic Cart. Diamond 1 Mil Stylus $10.00 Extra

New offering of VM Hi-Fidelity, 3 speed record changer with or without metal base. A large special purchase makes this low sale price possible. Reg. net on VM-935 less cartridge was $36.67. Reg. net on VM-936 less cartridge was $45.47. The VM-935-936 Hi-Fi Series changers are equipped with two plug-in tone arm heads which will hold popular G.E. or Pickering single or dual play cartridges. Both have 4-pole motors for constant speed, hum free operation with a VR cartridge. Plays all 3 speeds and all 3 sizes. Will inter-mix 10" and 12" records of same speed. Shuts off after last record plays. Muting switch silences pickup during change cycle. Furnished with large 45 RPM spindle. Chassis size 13½ x 13¼ x 8½" high, 4½" above plate. Ship. wt. 12 lbs., with base 18 lbs.

VM-935HF, 3 speed Hi-Fi changer, less cartridge and base, only $29.95.
VM-935HF-GE with G.E. RPX-050A VR cartridge, $35.90.
VM-935HF-GED with "Golden Treasure" RPX-052A VR cartridge; 1 mil diamond and 3 mil sapphire styli, only $45.90.
VM-936HF, 3 speed Hi-Fi changer with metal base, less cartridge, Sale price, $32.95.
VM-936HF-GE with G.E. RPX-050A VR cartridge, $38.90.
VM-936HF-GED with G.E. RPX-052A "Golden Treasure" cartridge; 1 mil diamond, 3 mil sapphire styli, only $48.90.

4-SPEED COLLARO Latest 1957 model RC-456, Collaro 4 speed record changer. Plays all 4 speeds, 16, 33, 45 and 78 RPM both automatically and manually. Inter-mixes records of the same speed and shuts off after last record. Fast 6 second change cycle. Automatic disengagement of idler wheels eliminates flat spots that cause wow and flutter. Base size; 13½" wide, 12" deep. 4½" above motor board and 3" below. Model RC-456 Collaro 4 speed automatic record changer, less cartridge, Sale price, $34.50. RC-456 with G.E. variable reluctance cartridge with 3 mil sapphire and 1 mil diamond stylus, Sale price, $46.95. Large 45 RPM spindle, $3.30 extra.

New Model UA8, Monarch 4 speed imported High Fidelity record changer. Features a high fidelity 4 pole motor, 9" turntable with molded rubber pallet. Counter-balanced tone arm will accept any of the popular Hi-Fi cartridges. Plays all 4 speeds and all 3 sizes. Intermixes 10" and 12" records of the same speed and shuts off after last record plays. Base size, 10⅞" x 12¾". Ship. wt. 15 lbs. Large spindle for 45 RPM records, $1.65 extra.
Model UA8-H with ±222 Ronette Hi-Fi flipover ceramic cartridge, $27.95.
Model UA8-HD, same as above but with 1 mil diamond stylus, $37.95.
Model UA8-U with ±500 Goldring variable reluctance cartridge, $29.95.
Model UA8-UD, same as above but with 1 mil diamond stylus, $30.95.

4-SPEED WEBCOR New, 4 speed Model 152, Webcor "Magic-Mind" automatic record changer. Complete with G.E. RPX-050A variable reluctance cartridge. Plays all 4 speeds 16, 33, 45 and 78 RPM automatically. 7", 10" and 12" LP records can be inter-mixed. Magic-Mind feature will switch speeds automatically between 33 and 45 RPM depending on the size of the record. Has heavy 4 pole motor and 8" turntable with rubber pad. Shuts off after last record plays and has neutral position to prevent flat spots on drive wheels that cause wow and flutter. Base size, 13¾"x12". Ship. wt. 13 lbs. Sale price, $31.95. Large 45 RPM spindle, $2.94 extra.

3-SPEED VM VM-9560E, 3 speed automatic record changer with G.E. RPX-050A variable reluctance cartridge and metal base. Plays all 3 speeds, 33, 45 and 78 RPM and all 3 size records. Will inter-mix 10" and 12" records of the same speed. Shuts off after last record. Has heavy 4 pole motor. Base size, 13-3/16"x 11⅞" deep. 7¼" high. Ship. wt. 15 lbs. Sale price, $29.95. Large 45 RPM spindle $1.65 extra.

McGEE RADIO COMPANY PRICES F.O.B. KANSAS CITY. SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D. TELEPHONE VICTOR 2-5092 · 1903 McGEE ST., KANSAS CITY, MISSOURI

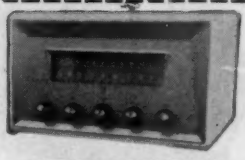
14 TUBE ESPEY HI-FI CUSTOM FM-AM CHASSIS $69.95

★ PUSH-PULL 6V6 OUTPUT
★ TWIN CONE CONTROLS
★ INPUTS FOR CRYSTAL OR V.R. PHONO, TAPE OR TV
★ WILLIAMSON TYPE CIRCUIT
★ ULTRA-LINEAR RESPONSE

MODEL HF-250C. A FULL HIGH FIDELITY AUDIO AMPLIFIER AND FM-AM TUNER—ALL ON ONE CHASSIS

REGULAR $119.50 VALUE

SALE PRICE **$69.95** LESS SPEAKER AND CABINET



LEATHERETTE COVERED CABINET $7.85 EXTRA

Espey Model HF-250C, 14 tube FM-AM chassis with push-pull 6V6, 10 watt audio. A true Hi-Fidelity receiver built by a nationally famous maker of fine custom chassis. Ultra-linear output used in Williamson type circuit gives frequency response of 10 to 22,000 cps. Output taps of 4, 8, and 16 ohms. Separate RF stages for FM and AM assure high sensitivity. Temperature compensated FM front end for minimum drift. Separate bass and treble tone controls. Pre-amp for all types of magnetic cartridges. 2nd input for crystal phono, tape recorder or TV. 3 position equalizer for accurate reproduction of all records. Built-in antennas for both FM and AM. Response plus or minus 1 db from 10 to 22,000 cps. Harmonic distortion less than 1%. Sensitivity: FM, 8 mv for 30 db quieting; AM, 75 mv for 6 db signal to noise ratio. Off-on-volume and equalizer are combined on a concentric control. Has 2 AC outlets on rear of chassis. Beautiful edge lighted flywheel inertia slide rule dial. Size: 7¾"x13½"x10" deep. Ship. wt. 24 lbs. (not mailable). Model HF-250C Sale price, $69.95. Espey chassis with our PTS-CR, 15" coaxial PM speaker, both for $88.95. Espey chassis with $54.95 list, model 9760M, 12" Phillips speaker, both for $89.95. Espey chassis with $99.95 list, model 9762M, 12" Phillips speaker, both for $104.95.

Beautiful modern tone tan leatherette covered cabinet to house the HF-250C Espey chassis for custom installations. Also, will fit the 500G Espey tuner shown on the opposite page. High quality, sturdy plywood cabinet expertly covered with modern tan leatherette material. Size, 15" long, 8½" high and 10¾" deep. Stock No. LEC-80, Custom leatherette covered cabinet. Ship. wt. 7 lbs. Order with your Espey chassis for only $7.95 extra.

SAVE ON NORELCO SPEAKERS AT McGEE

LATEST IMPORTED 8" AND 12" HI-FI PM's

8"—9750 $15.95 8"—9770 $7.95 12"—9762-M 12"—9760

The choice of Hi-Fi PM speakers, imported from Holland. Made by the internationally famous Phillips company. Twin cones are operated by the same super high efficiency Alnico magnet. The small center cone extends the audio range and loudness above 10,000 cps. Better and more natural pound reproduction. Extra number of gauss means more bass efficiency.

World Famous Hi-Fi	Imported From Holland
12" Model 9762-M reg.	$59.97 Sale Price $39.95
12" Model 9760 reg.	$32.97 Sale Price $19.95
8" Model 9750 reg.	$22.17 Sale Price $15.95
8" Model 9770 reg.	$ 9.90 Sale Price $ 7.95

NORELCO Model 9762—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice Coil imp. 8 ohms—new Alnico VI magnet gives 11,000 gauss. Regular $59.97 net, on sale at McGEE for only $39.95.
NORELCO Model 9760—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice coil imp. 8 ohms—new Alnico VI magnet gives 8,000 gauss. Regular $32.97 net, on sale at McGEE for only $19.95.
NORELCO Model 9750—8" wide range Hi-Fi PM speaker, res. 50 to 20,000 cps at 10-watts. Voice coil 6 ohms—New Alnico VI magnet gives 13,500 gauss. Regular $22.17 net, on sale at McGEE for only $15.95; or 2 for $30.00.
NORELCO Model 9770—8" wide range Hi-Fi PM speaker, res. 75 to 19,000 cps. New Alnico VI magnet gives 11,000 gauss. Reg. $9.90 net, on sale at McGEE for only $7.95; or 2 for $15.00.

NEW TYPE "T" STANDARD COIL

SINGLE STRIP TV TUNERS

PENTODE TUNERS **$9.95** CASCODE TUNERS **$12.95**

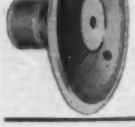
2 FOR $19.00 2 FOR $25.00

New, "T" type, single strip Standard Coil Cascode tuner. Available for 21 mc and 41 mc, for either series or parallel filaments with various shaft lengths. This is the latest single strip, 12 position, 12 channel VHF tuner with ¼" shaft having ⅜" concentric fine tuning shaft. You can replace all of the older model 2 strip tuners with these. Ship. wt. 3 lbs. Your choice of tuner with 1¼", 2½" or 3½" shaft length. Sale price, $12.95 each, 2 for $25.00.
Tuners with 4", 4½", 5", 6½" 7", 8¼" or 10½" shaft lengths. Sale price, $13.95 each, 2 for $27.00.
No. TCA-050, 2 tube 21 mc Cascode tuner with parallel filaments. Replaces 2000, 2200, 2300, 4200 series and others. Complete with 6BQ7 or 6BZ7 and 6J6 tubes.
No. TD-050, 2 tube 41 mc Cascode tuner with parallel filaments. Replaces TV-3000, 4400, 5000, 6500, 8000 and 8500 series. Complete with 6BZ7 or 6AT8 and 6J6 tubes.
TDS-050, 2 tube 41 mc Cascode tuner with series filaments. Complete with 4BQ7 and 5BR8 tubes.
No. TDC-050, 2 tube 41 mc Cascode tuner with series filaments. Complete with 4BQ7 and 5BR8 tubes.
No. TCS-050, 2 tube 21 mc Cascode tuner with series filaments. Complete with 4BQ7 and 5J6 tubes.

New, "T" type, single strip Standard Coil Pentode tuners. Available for 21 mc and 41 mc, for either series or parallel filaments. These are the latest single strip type tuners. 12 position, 12 channel VHF with regular ¼" shaft having ⅜" concentric fine tuning. Your choice of tuner with 1¼", 2½" or 3½" shaft length. Sale price $9.95 each, 2 for $19.00.
Tuners with 4", 4½", 5", 6½", 7", 8¼" or 10½" shaft lengths. Sale price, $10.95 each, 2 for $21.00.
No. TAA-050, 2 tube 21 mc Pentode tuner with parallel filaments. Complete with 6BC5 and 6J6 tubes. Replaces TV-100, TV-300, TV-500, TV-1200, TV-1300 and TV-1500.
No. TAS-050, 2 tube 21 mc Pentode tuner with series filaments. Complete with 3BC5 and 5J6 tubes.
No. TB-050, 2 tube 41 mc Pentode tuner with parallel filaments. Complete with 6BC5 and 6AT8 tubes.
No. TBS-050, 2 tube 41 mc Pentode tuner with series filaments. Complete with 3BC5 and 5AT8 tubes.

Set of matched knobs for above Standard Coil tuners. Molded mahogany bakelite with gold markings and metal inserts. Stock No. SCK-2 pair of knobs for channel selector and fine tuning, 59¢.
Set of matching mahogany bakelite knobs for volume and contrast, Stock No. VCK-2, 59¢ per pair.

FAMOUS 12" NORELCO PM SPEAKER



MODEL 9762-05 REGULAR NET WAS $59.97 McGEE SCOOP PRICE **$29.95**

McGee Scoop. Genuine Norelco 9762-05 extended range high fidelity 12" PM speaker. 11,000 gauss. Heavy 37 oz. Alnico V magnet. Rated 20 to 30 watts audio. Response 35 to 18,000 cps. Regular $60.00 net value. Has extended range bakelite dispersion feature built-in center of cone to extend high frequency range. Never before have we had such a terrific value on this genuine Norelco 12" speaker. Made in Holland. Stock No. 9762-05. McGee's sale price, $29.95.

RADIO NEWS SPECIAL **$42.95**

JUKE BOX

• 15" SUPER WOOFER • HORN TWEETER • LC CROSSOVER

Radio News Special. Matched speaker system for 8 ohm output tap of your high fidelity amplifier. You get $52.85 worth of speakers at our low price of only $42.95. Up to a $90.00 value if purchased elsewhere. 1500 cycle LC crossover network, plus horn type tweeter and 38 watt, 15" Utah, regular $60.00 list, 2 lb. magnet, 2" voice coil woofer. This system will give realistic audio response. Mount in any good baffle and you have it. It's about all there is, there ain't no more. McGee's fall special for Radio & TV News, only $42.95. Stock No. WF15R-HHLC, 35 watt speaker system. Response 15 to 20,000 cps.

SENIOR 8 HI-FI

LOW COST 2-SPEAKER SYSTEM **$19.95**

Senior 8, 1956 model, low cost speaker system in blend cabinet 20½" tall, 25" wide, 19½" front to back. Acoustically lined speaker enclosure with 8", 8.8 oz. Alnico V magnet mid-range speaker and 4" cone tweeter with crossover network. Will take 12 watts from 40 to 15,000 cps. Our "Most for the money" Hi-Fi speaker system in a can. Stock No. Senior-8. Sale price, $19.95. 10% off if you order with any of our amplifiers or radios offered in Radio & TV News.

IMPORTED HI-FI HORN TWEETER UP TO 16,000 CPS—SALE PRICE $16.95

Pioneer Model PT-3, 20 watt imported Hi-Fi tweeter speaker. Frequency response flat from 1500 to 16,000 cps. Tested for us by a leading college whose response curve ran from 1500 to 20,000 cps. Finest imported tweeter we have found. Equal to American made tweeters selling up to $50.00 or more. Specify 8 or 16 ohm voice coil when ordering. Stock No. PT-3, Sale price, $16.95.

TWO-TUBE SARKES-TARZIAN TV TUNER WITH TUBES

21 MC PENTODE OR 41 MC CASCODE

SALE PRICE **$7.95** 2 FOR $14.95

No. TT-3A, 2 tube 21 mc Sarkes-Tarzian Pentode TV tuner. 12 position, 12 channel VHF complete with 6J6 and 6BC5 tubes. This popular tuner used in Arvin, Air King, Airline, CBS, Crosley, Firestone, Truetone, Wallicrafters, Westinghouse and others. Specify shaft length, 2½", 3½" or 2¾". Ship. wt. 2 lbs. Sale price, $7.95 ea., 2 for $14.95. Available with longer shaft 3¼" to 9" long at $1.00 extra. SCK-2, set of matching knobs for selector and fine tuning, 59¢.

No. TT-2C, 2 tube 41 mc Sarkes-Tarzian Cascode TV tuner. 12 position, 12 channel VHF switch type. Complete with 6BZ7 or 6BQ7 and 6J6 tubes. This popular tuner used in many makes of TV sets; including Arvin E43703, E40128, Silvertone E40352 and Westinghouse V11485. Available with shaft 3¼", 4" 4¼" and 4½" long. Ship. wt. 2 lbs. Sale price, $7.95 each, 2 for $14.95. For 9" shaft, add $1.00. SCK-2, set of matching selector and fine tuning knobs, 59¢.

No. ST-4B, 2 tube 41 mc Sarkes-Tarzian Pentode tuner. 12 position, 12 channel VHF complete with 6AK5 or 6BC5 and 6J6 tubes. Used in Westinghouse models V-9886, V-10780, V-10808 and V-11388-1. Shaft lengths 3¼" and 3½". Ship. wt. 2 lbs. Sale price, $5.95 2 for $10.95. SCK-2, set of matching selector and fine tuning knobs, 59¢.

No. TT-1A, 2 tube 41 mc Sarkes-Tarzian Cascode TV tuner. 16 position switch type for 12 channel VHF and 4 positions for UHF converter (UHF converter not furnished). Complete with tubes, 6BZ7 and 6K8. Has 3¼" shaft for Westinghouse V-11333-1, etc. Sale price, $5.95 each, 2 for $10.95.

No. TT-5D, 2 tube 41 mc Sarkes-Tarzian Cascode TV tuner. 14 position switch type for 12 channel VHF and 2 positions for UHF converter. (UHF converter not furnished). Complete with tubes, 6BZ7 and 6U8 and channel selector knob. For Westinghouse models V-11794-1 and V-12400-1. Shaft length 7½". Sale price, $5.95 each, 2 for $10.95. Available 9½" shaft at $1.00 extra.

No. TT-6A, 2 tube 41 mc Sarkes-Tarzian Pentode TV tuner. 16 position switch type for 12 channel VHF and 4 positions for UHF converter. (UHF converter not furnished). Complete with tubes, 6CB6 and 6K8. For Westinghouse model V-10880-2, also Arvin. Shaft length 3¼". Sale price, $5.95 each, 2 for $10.95.

GOLDRING V. R. CARTRIDGE

WITH 2 SAPPHIRE STYLII $5.95
WITH 1 MIL DIAMOND, 3 MIL SAPH. $13.95

McGee offers the internationally famous Goldring variable reluctance phone cartridge, made in England and sold throughout the world to those who want the finest and most accurate music reproduction from 33⅓, 45 and 78 RPM high fidelity phone records. (Input gain and compensation similar to G.E. v.r. cartridge required.) Furnished as standard equipment with sapphire 1 and 3 mil styli. A regular $9.90 net item on sale at McGee for $5.95. For $13.95 with a diamond 1 mil stylus. These are the latest production, individually cartoned turnover cartridge with mounting bracket. Fits tone arms on most changers. Made for and bearing the famous Wilcox-Gay Recordio name. No. 546 Goldring V.R. (Wilcox-Gay) cartridge, Net $5.95. No. DB46-DS, Goldring V.R. (Wilcox-Gay) cartridge with diamond 1 mil stylus, $13.95. 1 mil diamond stylus for Goldring V.R. cartridge, purchased separately, $9.95.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL SENT C.O.D.

TELEPHONE VICTOR 2-5092
1903 McGEE ST., KANSAS CITY, MISSOURI

NEW 1958 MODEL SLIM LINE HI-FI AMPLIFIER $34.95

SLIM LINE SL-20

16 WATTS **$34.95**

PUSH PULL EL-84

RESPONSE 15 CPS TO 22,000 CPS

ORDER WITH A SPEAKER AND SAVE

★ WITH CU-14Y 12" COAX $44.95 ★ WITH B-125X SPEAKER $51.95
★ WITH P15-CR 15" COAX 54.95 ★ WITH B-347 SPEAKER 69.95
WITH NORELCO 12" 9762-M $69.00

New, 1958 model Imperial Slim-Line 16 watt high fidelity amplifier (26 watts peak), with built-in pre-amplifier. Full range audio response from 15 to 22,000 cps. Dual tone controls; full 18 db bass and full 15 db treble boost. Input for radio tuner, tape recorder and phono. Input compensation for the new 1958 model, 4 gram General Electric variable reluctance cartridges, as well as the famous G.E. RPX-050, RPX-052 and crystal phono cartridges. 5 position selector switch selects inputs and record compensation. Compensation for AES and RIAA phono records. A factory built amplifier at less than kit prices. Output impedance matches 8 or 16 ohm high fidelity PM speakers. Price includes tubes: 2—12AX7, 1—12AU7, 2—EL-84 and 5Y3GT. Modern multi-color leatherette covered wood cabinet, matches blond or mahogany finish speaker systems. Size: 5¼" tall, 11¼" wide, 8" front to back. Ship. wt. 15 lbs. Model SL-20 Imperial, List price $49.50. McGee's Sale price, $34.95.

SLIM LINE SL-10

12 WATTS **$24.95**

PUSH PULL 6V6

RESPONSE 20 CPS TO 17,500 CPS

ORDER WITH A SPEAKER AND SAVE

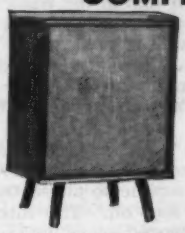
★ WITH CU-14Y 12" COAX $34.95 ★ WITH B-125X SPEAKER $41.95
★ WITH P15-CR 15" COAX 44.95 ★ WITH B-347 SPEAKER 59.95
WITH NORELCO 12" 9762-05 $49.95

New, 1958 model Imperial Slim-Line, 12 watt high fidelity amplifier (16 watt peak), with built-in pre-amplifier. Full range audio response from 20 to 17,500 cps. Dual tone controls, full 12 db bass boost and full 15 db treble boost. Input for radio tuner or tape recorder and phono. Input compensation for the new, 1958 model 4 gram General Electric variable reluctance cartridge as well as RPX-050, RPX-052 and crystal phono cartridges. Compensation for AES and RIAA phono records. A factory built amplifier at a price you might pay for a kit that actually included less material. Output impedance matches any 8 ohm high fidelity PM speaker. Price includes tubes: 2—12AX7, 2—6V6GT and 5Y3GT. Modern multi-color leatherette covered wood cabinet, matches blond or mahogany finish speaker systems. Size: 5¼" tall, 11¼" wide and 8" front to back. Ship. wt. 12 lbs. Model SL-10 Imperial, List price, $49.50. McGee's Sale Price, $24.95.

COMPLETE 1958 MODELS HI-FI SPEAKER SYSTEMS IN BAFFLES

"HOLLYWOOD STYLING"

AT PRICES YOU MIGHT PAY FOR AN ENCLOSURE ALONE



MODEL H-4H. 4 SPEAKER SYSTEM IN BAFFLE **$39.95**

MODEL Z-4Z SYSTEM **$49.95**

New, 1958 Hollywood 4-speaker systems are designed to give realistic reproduction from your Hi-Fi amplifier or FM-AM radio. Juke box full bass with variable brilliance control. Genuine LC crossover network built-in. Ideal for use with our Slim-Line 12 and 20 watt high Fidelity amplifiers, as well as our Espey and Hallicrafters chassis. Small in size to be attractive, yet large enough to baffle properly. Fully enclosed and acoustically lined. Take $3.00 discount if you order with any amplifier or the Espey chassis. Specify mahogany, walnut or blond when ordering, otherwise we will ship mahogany.

IMPERIAL 80 SPEAKER **$69.95**

IMPERIAL 90 SPEAKER **$89.95**

FULL 10 CU. FT.

Choice of Blond, Mahogany or Walnut, speaker enclosure used with the 2 Imperial systems described below. Size 39" high, 24" wide and 23½" deep. Over 10 cu. ft. of volume in this fully enclosed speaker cabinet. Beautiful finish with matching grill cloth covering entire front. Speakers are mounted on a heavy plywood baffle. Enclosure is lined with an acoustical material. Speakers and crossover network are wired up, ready to connect to 8 ohm output. Mahogany shipped if no color is specified.

MODEL H-4H SYSTEM $39.95

Model H-4H Hollywood 4 speaker high fidelity speaker system. 20 watts, response 20 to 17,500 cps. Choice of Mahogany or Walnut or Blond finish enclosure. Features a 12" General Electric 8.8 oz. Alnico V magnet, aluminum voice coil woofer, plus 6" mid-range and 3½" tweeters. Built-in variable brilliance L-C crossover network. Model H-4H, Ship. wt. 35 lbs. Price, $39.95.

MODEL Z-4Z SYSTEM $49.95

Model Z-4Z, Hollywood 4 speaker high fidelity speaker system. 25 watts, response from 18 to 17,500 cps. Choice of Mahogany or Walnut or Blond finish enclosure. Features a 15", 21½ oz. Alnico V Utah heavy duty woofer, plus 6" mid-range and 2-3" tweeters. Built-in variable brilliance. L-C crossover network. Model Z-4Z, Ship. wt. 57 lbs. Sale price, $49.95.

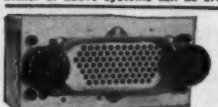
Either of above systems can be ordered in larger baffle shown at right for $5.00 extra.

IMPERIAL 80 $69.95

25 watts response, 18 to 20,000 cps. A complete speaker system in the above described enclosure, ready to connect to your Hi-Fi amplifier. Built-in L-C, 3 way crossover network. Speakers included are 15", 21½ oz. Utah woofer, 6" 8.8 oz. mid-range and horn type Pioneer PT-3 tweeter. 8 ohms impedance. Stock No. Imperial 80, speaker system. Ship. wt. 80 lbs., Sale price, $69.95.

IMPERIAL 90 $89.95

Imperial 90, 30 watt speaker system with 5 speakers. Response, 18 to 20,000 cps. A complete speaker system in the above enclosure, ready to connect to the 8 ohm output of your high fidelity amplifier. Includes the 21 oz. Utah 15" woofer, two of the 6", 8.8 oz. mid-range speakers and two of the PT-3 Pioneer horn type tweeters. Built-in L-C type, 3 way crossover network. Imperial 90, speaker system. Ship. wt. 90 lbs., Sale price, $89.95.

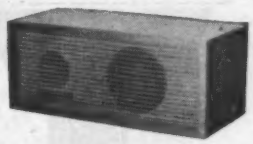


SALE PRICE **$17.95**

$49.95 list value auto radio. Nash Model NH3C for '53 Nash Rambler, made by Motorola. Works on 6 volt storage battery. Custom built, 8 tube superhet receiver. Broadcast range 540 to 1600 KC. Complete with tubes: 6AV6 det. AVC amplifier, 6BA6 I.F. amplifier, 6BE6 converter, 6A5S audio output and 6X4 rectifier. Has built-in 4x6" PM speaker. With some ingenuity this set can be adapted to fit many other auto installations which have 6 volt system. Overall size; 10½" long, 5¼" high, 4½" deep (6" with knobs.) Knobs on 2½" centers. Ship. wt. 15 lbs. Stock No. NH3C, General purpose 6 volt auto radio. Sale price, $17.95 each, 2 for $34.00.

New 1958 IMPERIAL 5 $16.95 IN CAB.

8" HI-FI SPEAKER WITH 5" CONE TWEETER



New, 1958 model Imperial 5, speaker system (bookshelf size). Leatherette covered wood cabinet size; 10"x10"x24" long. Fully enclosed and acoustically lined. Use with any 8-ohm output Hi-Fi amplifier. Very good where space is a factor, yet good tone reproduction is desired. Equipped with a Hi-Fi 8" Alnico V PM middle and low frequency range speaker, featuring a cone within a cone, plus a 5" tweeter and crossover. Response 40 to 15,000 cps. from 3 to 10 watts. Ship. wt. 14 lbs. Stock No. IMP-5, 2-way Hi-Fi speaker system, Sale price, $16.95.

NEW 8 TUBE 6 VOLT PUSH-BUTTON MODEL $37.95

New model SH-78555-X, 8-tube, 6-volt universal mounting auto radio with push buttons and 6x9 speaker. Made for Hudson cars, but their compact construction lends them to underdash installation. Has push-pull 6AQ8 high-powered audio. Stock No. SH78-555-X with 6x9 speaker—$37.95. With 2 — 5x7 speakers — $39.95; with 1—5x7 speaker $37.95. Specify speaker size wanted. Three-section top cowl mounting antenna —$2.29 extra.

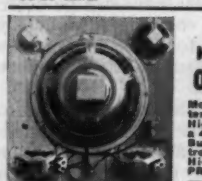
5 Station Intercom Master

Sale Price $19.95

Sub Stations $3.95 Each

3 for $10.00

New, 1958 model office and business intercom master for use with up to 5 sub stations. Selective type, to call from 1 to 5 subs privately or together. Talk-listen switch gives master control of conversation. Made for 110 volt AC-DC operation. Complete with 3 tubes including rectifier. Housed in an attractive modern design proxilin covered wood cabinet, 5¼" high, 11" long and 8" front to back. Stock No. MMS-5, 5 station intercom master. Sale price, $19.95. Small square matching sub-station with "call-in" switch. Stock No. MN-5, $3.95 each, 3 for $10.00. 3 wire intercom cable for use with above system, $1.95 per 100 ft., 500 ft. for $8.95.



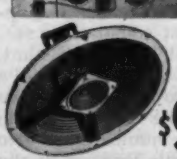
1958 MODEL Speaker Systems ON BAFFLE BOARDS **SALE PRICE $18.95**

Model B-125-X, high fidelity 15-watt, 5-way speaker system, mounted on an 18" square baffle board. Has 12" High Efficiency woofer, 2—4x6" mid-range speakers, plus a 4" high-range and 3" tweeter; all with Alnico V magnets. Built-in LC crossover network with variable brilliance control. Ship. wt. 11 lbs. Stock No. B-125-X, 5-way, 15-watt Hi-Fi speaker system. AUDIOPHILE VALUE $30.00. SALE PRICE, $18.95.

Model B-347, high fidelity 30-watt, 5-way speaker system, mounted on a 30"x24" baffle board. Has 18" UTAH 21½-oz. woofer, 2-new high fidelity extended range 6x9" speakers, plus 2-5" tweeters; all with Alnico V magnets. Built-in LC crossover network with variable brilliance and presence controls. Ship. wt. 22 lbs. Stock No. B-347, 5-way, 30-watt Hi-Fi speaker system. AUDIOPHILE VALUE $59.95. SALE PRICE, $39.95.

SALE PRICE $39.95

Mount these Hi-Fi speaker systems in your own cabinet or use for custom installation. Ideal for use with any radio or amplifier. Completely wired, with only 2-wires to connect to any 8-ohm output (Take 10% discount if ordered with any radio or amplifier listed hereon.) Grill cloth, 75¢ extra.



12" COAXIAL PM SPEAKER RESPONSE 25-17,000 CPS

$9.95

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PUSH PULL 6Y6
TWIN TONE CONTROLS
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30 TO 15,000 CPS
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Model HF-22, high fidelity audio amplifier. 18 watts to 22 watts peak, from 30 to 15,000 cps. Size: 6"x11½"x7¼" tall. Inputs for mike, phono and tuner. Built-in pre-amp for G.E. variable reluctance and crystal phono cartridges. Output matches 8 ohm voice coil. Separate bass and treble controls. A factory wired amp at kit price. With tubes: 12AT7, 12AU7, 2—6Y6G and 5U4. Ideal for industrial music. Priced with 8" twin cone Hi-Fi PM speaker at $27.95. HF-22 amplifier alone, Ship. wt. 10 lbs. Sale price, $24.95.

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YEATS Model No. 5
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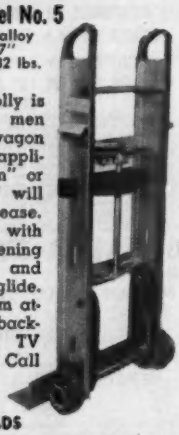
Folding platform is 13½" x 24½"—attaches instantly. (Platform only) $9.95.



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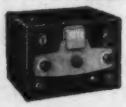
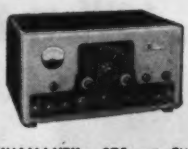
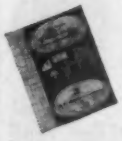


VIKING "ADVENTURER"—An ideal 50 watt CW transmitter for the novice or experienced amateur. Effectively TVI suppressed . . . built-in power supply . . . bandswitching 80 through 10 meters. Easy to build and safe to operate. Complete with tubes, less crystal and key.
Cat. No. 240-181 Kit.....Amateur Net $54.95

build your own amateur transmitter from these 3 easy-to-assemble kits!

VIKING "RANGER"—Tops for operating convenience—enough power for world-wide contacts! Built-in VFO or may be crystal controlled. Bandswitching 160 thru 10 meters. 75 watts CW input—65 watts phone. TVI suppressed—with tubes, less crystals, key, microphone.
Cat. No. 240-161-1 Kit....Amateur Net $214.50
Cat. No. 240-161-2 Wired. Amateur Net $293.00





VIKING "VALIANT"—275 watts CW and SSB (P.E.P. input with auxiliary SSB exciter) 200 watts phone! Bandswitching 160 thru 10 meters. Built-in VFO or crystal control. Wide range pi-network output—TVI suppressed—high gain push-to-talk audio system. With tubes, less crystals, key and microphone.
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Spot Radio News

(*Continued from page* 14)

President stating her problem in complete detail. During a second visit by an FCC engineer from the Chicago office, it was found that the disturbance had been eliminated. The method used to cure the trouble was unique. On a day when the lady of the house was away, the amateur, with the consent of the woman's husband, but without her knowledge, installed a wavetrap and line filter on the set to make up for the chassis' poor interference-rejection capabilities.

Another item on the FCC books told of a complaint of poor TV visibility by 60 families sharing a master TV antenna on a Connecticut apartment building. Inquiry revealed that the trouble extended over an area containing 500 receivers. An FCC engineer found that the condition was caused by a defective flashing neon sign in the window of a local finance company. Turning off the sign and subsequently having it repaired eliminated the problem.

Elsewhere, a Minnesota airfield reported that there was constant disruption to its aircraft communications over a radius of 50 or more miles. Thanks to bearings taken by a mobile unit, FCC engineers found the culprit to be a common electric doorbell half a mile away from the airport. The bell's transformer, which contained a temperature-control strip with contacts, had become so pitted that the connection alternately went on and off. The interference stopped when the bell was silenced.

THE FCC REPORTS also commented on the great lengths to which manufacturers, and particularly users of industrial-heating equipment, are going to curb interference from this type of apparatus. One firm, harassed by continuing complaints of interference, decided to correct the situation itself, since a commercial outfit indicated that it would take months to provide the necessary shielding. So plant personnel constructed a shielded room 70 x 30 x 15 feet at a cost of $3000. Then the plant called in an engineer to be sure that the shielding provided the required FCC interference safeguards. And, to make doubly sure that every precaution had been taken to curb interference, the plant's own engineer installed a meter in his office to keep a check on radiation.

AN ELECTRONIC PLATFORM at 40,000 feet, involving a pair of B-57 jets, is now being used by the CAA to check airway facilities.

For the first time by either civil or military forces, the exact situation of en-route and terminal aids at the altitudes at which planes of the future will fly—20,000, 30,000 and 40,000, and even up to 50,000 feet—can be determined by scientific measurement and checking. Previously, the CAA had no planes able to fly up to 40,000 feet and the military has had only random and unsubstantiated reports by pilots flying in the upper altitudes.

Now, thanks to elaborate electronic equipment, automatic recorders, computers, and other apparatus, a two-man crew of a jet can provide voluminous information.

There's not only about seven miles of wiring, 148 connectors, and four large junction panels in the jet, but the nose, bomb bay, and rear observer's station are packed with radio equipment and spares. The plane's position in space can be pinpointed with an accuracy of 500 feet, even when flying 525 miles an hour at 40,000 feet.

This is how the plane's gear works: In the vicinity of an airway aid, either a radio range, an instrument landing system, or a fan marker, two distance-measuring-equipment transmitters in the plane broadcast signals to d.m.e. stations on the ground, preferably about 90 miles distant. These ground stations automatically answer back and a counter gives the time it takes the two signals to make the round trip (in microseconds). The operator then presses a button and takes down the numbers on two counters. By triangulation, the geographic location of the plane can be determined with an accuracy of plus or minus 500 feet.

The button pressed by the pilot makes a mark on a roll of paper and prints a number on it. This same number is written by the operator on his microsecond readings. Meanwhile, receivers and measuring devices in the plane are recording continuously all sorts of information needed to determine the efficiency of the airway aid being checked and the analysts on the ground can determine exactly the situation at the second the button is pressed and at the point where the plane is located.

A pilot and electronic engineer, who comprise the B-57's crew, occupy the cockpit and a cubbyhole just to the rear of the pilot, surrounded completely by special gear, plus the usual fittings of the plane which include explosive-powered ejection devices for leaving the plane in emergencies.

A FORMER FCC CAREER LAWYER is now on the Commission. He is Frederick W. Ford, former chief of the FCC hearing division, who resigned in 1953 to join the Department of Justice.

Replacing retired FCC Chairman George C. McConnaughey, he will serve for a seven-year term, running to 1964.

The new bossman of the FCC is John C. Doerfer, who has been a Commissioner since 1953.

A $1,100,000 ORDER has been placed with the *Eclipse-Pioneer Division* of *Bendix Aviation* to equip the new Convair jet airliners with the recently developed automatic all-transistorized flight controls systems.

The new control equipment has miniaturized components arranged in a series of plug-in type electronic cards which measure 3 x 4½ inches. The cards slide in and out of a centrally located box.

Capable of capturing a radio beam from any angle, the new systems can hold the plane on radio flight paths and landing approaches or follow course commands set in by the pilot. Automatic steering controls are incorporated for manual maneuvering of the plane.

THERE WAS REAL ACTIVITY at FCC headquarters before the doors were closed for summer vacation.

Highlight of the closing days' sessions was a decision to make the Albany-Schenectady-Troy, New York area all-v.h.f.

By a majority of four, the Commission approved the retention of Channels 6 and 10 in Schenectady and Vail Mills (suburb of Albany) and the adding of Channel 13 to the area from Rome-Utica, New York.

ONE OF THE LESSER KNOWN services of the Bureau of Standards is the broadcasting of a musical tone of standard pitch—middle A at 440 cps—over its short-wave stations WWV (Beltsville, Md.) and WWVH (Maui, Hawaii). Since a short-wave receiver is all that is needed, easy access to standard pitch is thus provided for piano tuners and amateur and professional musicians as well as for makers of musical instruments.

Also broadcast is a 600-cps tone. This, together with the 440-cps note, is used by scientists, electronics engineers, and manufacturers to calibrate instruments and devices that operate in the audio and ultrasonic ranges.

The two frequencies are broadcast alternately, starting with 600 cps on the hour for three minutes, interrupted two minutes, followed by 440 cps for three minutes and interrupted two minutes.

To provide greater assurance of reliable reception, transmissions from the NBS stations are made simultaneously on several standard broadcast frequencies. WWV broadcasts on 2.5, 5, 10, 15, 20, and 25 mc. and WWVH transmits on 5, 10, and 15 mc.

From a technical point of view the present standard of musical pitch, as maintained by the Bureau, has the advantage that it is free from the vagaries of the material objects (tuning forks, organ pipes, etc.) that embodied past standards. Thanks to modern electronic techniques for generating and stabilizing oscillations, a tone is produced that, for all practical purposes, is independent of the temperature of the surroundings. . . . . L. W.

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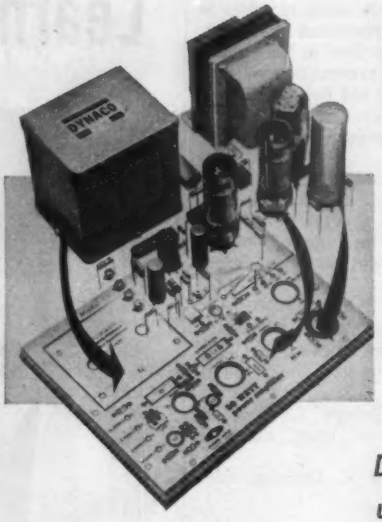


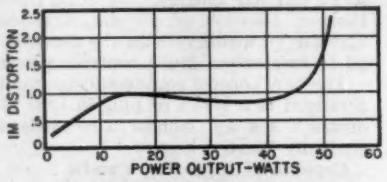
The "Peri-50" Power Amplifier

Details on a unique printed-circuit unit which is offered in kit form.

NOT only are kits becoming easier to assemble but one manufacturer even supplies the required pencil-type soldering iron. The only tools needed to put such kits together are a screwdriver, long-nose pliers, and cutters, in addition to the soldering iron.

This is true of the new "Peri-50" power amplifier being offered in kit form by Printed Electronic Research Inc., 4212 Lankershim Blvd., North Hollywood, Calif. The new amplifier is built on a printed circuit board. All components and lead connections are so clearly identifiable by markings on the printed board that it could be assembled by a novice without reference to any printed instructions.

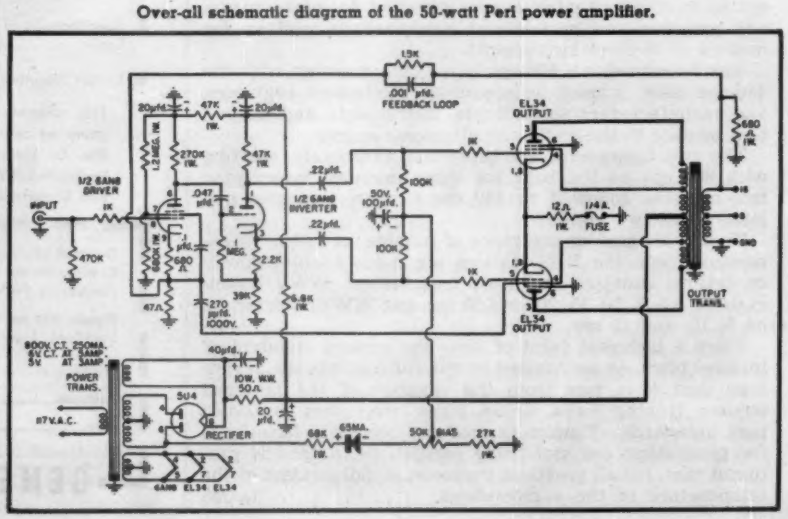
The circuit uses four tubes. The output stage is a conventional Mullard design using EL34/6CA7's. A 6AN8 is used as a phase inverter and driver, with a 5U4 as a power rectifier. Basically, in many respects, the design is somewhat similar to the "Dynakit." In fact, the same Dyna output transformer, the A-430, is used in both amplifiers. The only difference between these two units is that the "Peri-50" uses a capacity-coupled phase inverter instead of being direct coupled. It has a somewhat more conservatively rated power transformer, being designed for 250 ma. instead of 200 ma. There are several other minor differences—none of them of too much significance.



IM distortion as measured with a Heath audio analyzer. (60-7000 cps; 4:1 ratio, equivalent sine-wave power indicated).

Performance characteristics, as measured on one of the kits, were as follows: frequency response within ±.5 db from 20 to 20,000 cps (limit of audio oscillator used). The company claims that this response is available up to 30,000 cps at any level between 1 mw. and 50 watts. Hum and noise, with an open grid, was down 92 db from full output. For 50 watt output, an input of 1.05 volts is required. Damping factor at 1000 cps was 25. —30—

Over-all schematic diagram of the 50-watt Peri power amplifier.



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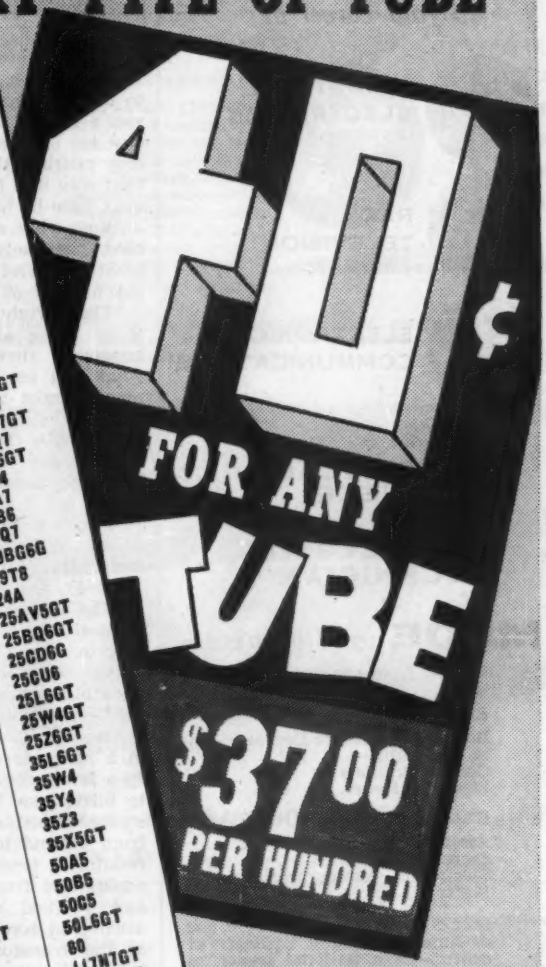

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0Z4	5AW4	6BK5	6U8	12SH7
1A7GT	5AZ4	6BK7	6V3	12SJ7GT
1B3GT	5J6	6BL7GT	6V6GT	12SK7
1C7G	5T4	6BN6	6W4GT	12SN7GT
1F4	5T8	6BQ6GT	6W6GT	12SQ7
1H4	5U4G	6BQ7	6X4	12V6GT
1H5GT	5U8	6BY5G	6X5GT	12X4
1J6GT	5V4G	6BZ7	6X8	14A7
1L4	5V6GT	6C4	6Y6G	14B6
1L6	5Y3	6CB6	7A5	14Q7
1LA6	5Y4G	6CD6G	7A7	19BG6G
1LC5	6AB4	6CF6	7B5	19T8
1LH4	6AC7	6CS6	7B7	24A
1LN5	6AG5	6CU6GT	7C5	25AV5GT
1N5GT	6AF4	6E5	7C6	25BQ6GT
1S4	6AH4GT	6H6GT	7C7	25CD6G
1S5	6AK5	6J4	7F7	25CU6
1T4	6AL5	6J5GT	7F8	25L6GT
1U4	6AM8	6J6	7N7	25W4GT
1U5	6AN4	6K6GT	7Q7	25Z6GT
1V2	6N8	6L6	7Y4	35L6GT
1X2	6AQ5	6N7GT	7Z4	35W4
2A7	6AQ7GT	6S4	12A6	35Y4
2D21	6AS5	6S7G	12AH7GT	35Z3
2X2	6AS7G	6SA7	12AT6	35X5GT
3A4	6AT6	6SB7Y	12AT7	50A5
3A5	6AU4GT	6SC7	12AU6	50B5
3AL5	6AU5GT	6SF5	12AU7	50C5
3AU6	6AU6	6SF7	12AV6	50L6GT
3BC5	6BU5GT	6SG7	12AV7	80
3CB6	6AV6	6SH7	12AX4GT	117N7GT
3Q4	6AX4GT	6SJ7GT	12AX7	117P7GT
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Are you eligible for veterans educational benefits? .....
Discharge date .....
MS-57

Do-It-Yourself Profits

(*Continued from page 57*)

Harry answered slowly. "You charge for your labor, you're certainly entitled to that. As far as the customer giving you a hard time, use a little psychology, try to smooth over the part about him putting the trouble in the set; that way he's not ashamed to call you next time he needs service."

"Boy, what a business," Jack grumbled, "not only do you have to be a technician and a business man, but a psychiatrist as well."

"That's right," Harry laughed, "and if by being all three, your business improves, then you've accomplished what you set out to do in the first place: make money. But seriously," he went on, "if you can leave a customer with the feeling that you're a regular guy, even though you both know he caused the trouble himself, you've got a customer you won't lose.

"Here's a job that proves my point, Jack." Walking over to the file cabinet, Harry pulled out a schematic (Fig. 4), and spread it on the bench.

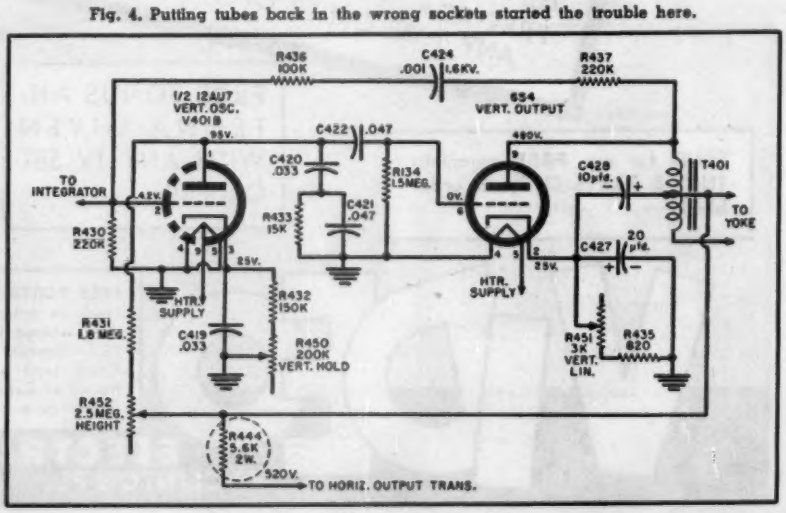
"The customer's complaint was no vertical sweep and the set was smoking. A visual check of the vertical circuit showed R_{111}, the 5600-ohm, 2-watt resistor, charred and discolored. It's not unusual for a 2-watt resistor to change value, so I tacked in a new one and turned the set on. In a few seconds, the new one started to blister, so I shut the set off and started resistance checks. Measuring from ground to the top of the burnt resistor, I read 1100 ohms. Checking resistances from ground to the yoke and vertical output transformer, I discovered zero ohms at the high side of the transformer. There's nothing in the circuit, as you can see, except maybe a shorted tube, that would allow such a low reading. I pulled the tube and measured it for a short. Sure enough pin #9, the plate, to pins #4 and #5, the filaments, showed continuity. I was about to reach for a replacement, when something about the shape of the tube struck me as being odd for a 6S4. It was odd all right, because it was not a 6S4 at all, it was a 12AU7, and a new one, too. As you have probably guessed, the other vertical tube, in the oscillator socket, *was* a 6S4. My predecessor had reversed the two tubes. As you can see by the schematic, pin #9 of the 12AU7 is the center tap of the filaments. When you place that tube in the 6S4 socket, pin #9 has 480 volts on it, which you pump right to ground through the filaments. It was just too much for R_{111}, so it started to fry.

"Later, when I explained to the customer what had happened, he admitted taking the tubes out, having them checked, and replacing several. I pointed out the tube lineup diagram on the side of the cabinet and recommended that he consult it the next time he replaced tubes. I further pointed out that the same thing could happen to anybody, including a TV technician, at which point he became more friendly and less embarrassed. When I saw I had gotten it across to him that I didn't resent his working on his own set, I was satisfied; I had secured my customer.

"Here's the whole thing in a nutshell, Jack; if you won't sell tubes to a do-it-yourselfer, somebody else will. If you won't try to help him out on minor repairs, such as tubes and adjustments, somebody else will. And, if you don't make an effort to hold onto him, as a customer, somebody else *sure* will. Do-it-yourself is here to stay; don't fight it, accept it, and every time you get a set in your shop with 'induced' trouble, just say to yourself, well this makes up for those last few tube jobs I missed out on."

"I see what you mean," Jack nodded his head in agreement, "I'll have to think this over, and make a few revisions in my battle tactics. Thanks for the lecture, Harry." —30—

Fig. 4. Putting tubes back in the wrong sockets started the trouble here.



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knight-kit High Fidelity FM-AM Tuner Kit

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- Latest Time-Saving Printed Circuit Design
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- Automatic Frequency Control
- 2.5 μv FM Sensitivity
- True High Fidelity Response
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The best-looking, best-performing FM-AM tuner kit your money can buy! Carefully designed for quick, easy construction—a tuner you'll enjoy assembling and be proud to own, both for its amazing musical performance and outstanding beauty. Covers the full AM broadcast band and 88 to 108 mc FM. On FM, *sensitivity is a remarkable 2.5 microvolts for 20 db of quieting;* hum and noise, −60 db; IF bandwidth, 200 kc at 50% down on curve; response, ± 0.5 db, 20-20,000 cps. On AM, *sensitivity is 3 microvolts for 10 db signal-to-noise ratio;* IF bandwidth, 8 kc at 50% down on curve; response, 20-8000 cps. Outstanding features include: Inertia Flywheel Tuning for effortless, accurate tuning; Automatic Frequency Control (plus AFC disabling) to "lock-in" FM stations; printed circuit board (with most of the kit wiring already done for you) assures time-saving, error-free assembly; pre-aligned RF and IF coils; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; two output jacks—one for recorder, one for amplifier; rotatable built-in ferrite antenna for AM. Includes beautiful French-gray case with chrome-finished tapered feet, 4 x 13 x 8″. Ideal for use with 18, 20 or 30 watt KNIGHT-KIT amplifiers. Ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-787. FM-AM Tuner Kit. Net only..... **$49.95**

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- The Last Word in Custom Hi-Fi Styling
- Full 18 Watts with Superb Hi-Fi Specifications
- 8 Inputs for Every Desired Signal Source
- Printed Circuit Switch and Printed Circuit Boards
- Full Equalization for All Record Types

Here is a custom-styled, easy-to-build complete Hi-Fi amplifier at a price that defies comparison. Delivers full 18 watts output with wide-range, flat frequency response for true hi-fi reproduction. Features 8 inputs for every possible signal source, including NARTB equalized tape head input. At full 18 watts output, distortion is only 0.5%; uses new RCA 6973 hi-fi output tubes. Frequency response is ± 1 db, 20-30,000 cps; tape head and magnetic cartridge sensitivity, 5 microvolts for 18 watts output; hum and noise level better than 60 db below 18 watts. Output taps for 4, 8 or 16 ohm speakers. Controls: Input and Record Equalization; Bass Boost and Attenuate; Treble Boost and Attenuate; Volume. Simplest assembly is made possible through the use of an exclusive printed circuit switch and two printed circuit boards—most of the kit wiring is already done for you. With custom-styled French-gray "space-saver" case on tapered feet finished in chrome, 4 x 13 x 8″. Complete with case, tubes, all parts, and step-by-step instructions, for easy, error-free assembly. Shpg. wt., 15 lbs.

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- Printed Circuit Switches • Printed Circuit Boards
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- Full 30 Watts Output • Custom-Styled Beauty

Comparable to the best in Hi-Fi—at far less cost! Deluxe features include: Linear-deluxe Williamson-type circuit for flawless response; equalization for all records within ½ db of recommended accuracy; 2 exclusive new printed circuit switches in preamp section (no complex wiring to do); 3 printed circuit boards for time-saving, error-free assembly; separate, continuously variable Level and Loudness controls; use of premium 12AY7 tube for low noise and hum; DC on all filaments of preamp tubes; exclusive A-AB-B speaker selector switch (use speakers of mixed impedances without mismatch). 8 inputs: Tape Head direct; G.E. and Pickering cartridges; Ceramic cartridge; Microphone; Auxiliary; Tape Preamp; Tuner (with separate Level Set control). Power amplifier response, ± ½ db, 15-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—IM, 0.74% at 20 watts. Separate Bass and Treble controls; rumble filter switch; variable damping. Output, 8 and 16 ohms. With smart French-gray cabinet, 4 x 15 x 15". Ready for easy, money-saving assembly. Shpg. wt., 32 lbs.

Model Y-762. 30-Watt Hi-Fi Amplifier Kit. Net only.....**$76.95**

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$38.95

Only $3.89 down

- Authentic High Fidelity FM Response
- Flywheel Tuning • Automatic Frequency Control
- Printed Circuit • Pre-Adjusted Coils and IF's
- 4 Microvolt Sensitivity Guaranteed

Here is top value in creative engineering, impressive hi-fi performance and distinctive design—a tuner you'll be proud to build and own. Covers the full FM band, 88 to 108 mc. Features Automatic Frequency Control (with disabling feature) to "lock-in" stations and prevent drift; Inertia Flywheel Tuning for velvet-smooth, accurate station selection; pre-adjusted RF coils; pre-aligned IF's; cascode broad-band RF amplifier; drift-compensated oscillator; neon bulb pointer. All critical wiring is already done for you in the form of a printed circuit board—assembly is simple. Sensitivity is 4 microvolts for 20 db of quieting across entire band; output, 2 volts at 1000 microvolts input; IF bandwidth, 200 kc; response, 20-20,000 cps. with only 0.6% distortion. Output jacks for amplifier and tape recorder; cathode follower output. Ideal for use with the KNIGHT-KIT amplifiers, or any amplifier with phono-tuner switch. Features custom-styled case in French-gray, with tapered chrome-finished feet, 4 x 13 x 8". Includes all parts, tubes and step-by-step instructions for easy assembly. Shpg. wt., 12 lbs.

Model Y-751. Hi-Fi FM Tuner Kit. Net only.....**$38.95**

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Only $8.95 down

- Pre-Finished "Quik-Craft" Corner Enclosure
- Klipsch Designed and Licensed
- Famous Knight 12" 3-Way Speaker
- Easy to Assemble—Top Hi-Fi Quality
- Choice of Enclosure Finishes

Deluxe quality high fidelity speaker system at a money-saving low price. Easy to assemble—all you need is a screwdriver. System includes KNIGHT "Quik-Craft" corner-type folded-horn enclosure kit, and the famous-value KNIGHT 3-Way 12-inch speaker. Just assemble the enclosure—*no finishing required*—all surfaces are finished in hand-rubbed Korina blonde, mahogany or walnut. The speaker is the new 3-way type: 12" woofer cone for bass (full 1¾ pound woofer magnet), conical radiator for mid-frequencies, built-in compression-type tweeter (with wired level control and calibrated dial) for highest frequencies. Unexcelled enclosure efficiency and superb speaker performance combine to cover the whole spectrum of audible sound for true hi-fi response from 35 to 15,000 cps, ± 3 db. Kit includes 12" 3-Way speaker, prefinished enclosure panels, grille cloth, hardware and instructions. *Specify Korina blonde, mahogany or walnut when ordering.* Shpg. wt., 44 lbs.

Model Y-937. 3-Way Speaker System Kit. Net only.....**$89.50**

knight-kit 10-Watt Hi-Fi Amplifier Kit

Y-753

$23.50

$2.35 down

Low-cost, authentic hi-fi amplifier. Response, ± 1 db, 30-20,000 cps. Input for crystal phono or tuner; chrome-plated chassis is punched for preamp kit below, to permit use of magnetic phono. Only 0.5 volt drives amplifier to full output. Separate bass and treble controls. Only 1% harmonic distortion. Matches 8-ohm speaker. 7 x 13 x 6". With all parts, tubes and instructions. Shpg. wt., 13 lbs.

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Y-235. Preamp Kit.....**$ 3.10**
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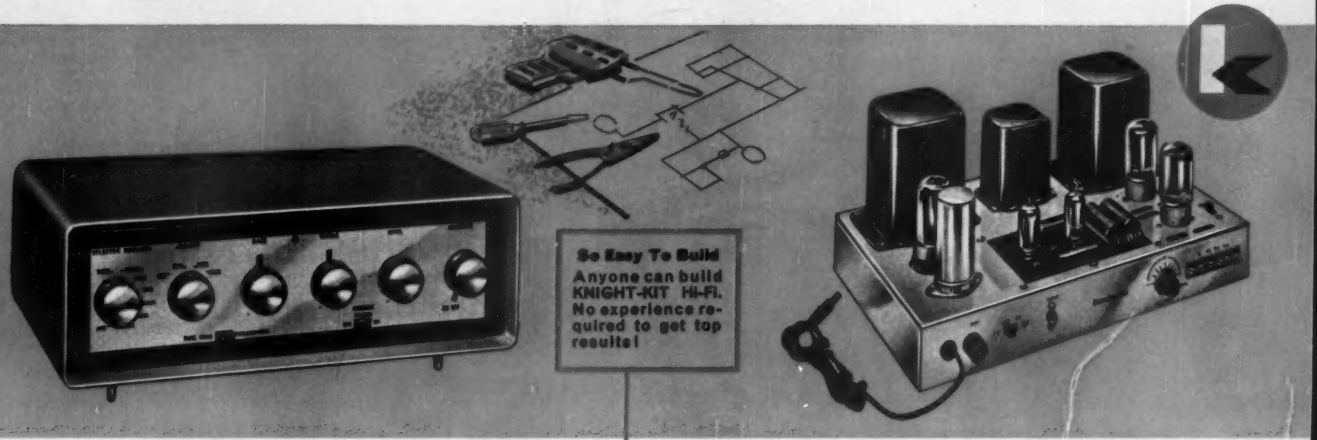

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- Exclusive Printed Circuit Switches and Boards
- Equalization ±¼ db of Recommended Accuracy
- 8 Inputs Including Tape Head
- Self-Powered
- DC on All Tube Filaments
- Custom-Styled

Sensational Hi-Fi design at amazing low cost. Provides precise record equalization guaranteed within ½ db of recommended accuracy!—more accurate than all but the most expensive factory-built preamps. Includes exclusive new KNIGHT-KIT printed circuit switches for easy, error-free assembly; 2 printed circuit boards eliminate all other wiring, except for power supply and control leads—so easy to build. Has built-in power supply; includes premium 12AY7 and ECC82 tubes. Frequency response, ± 0.5 db, 10-50,000 cps. Has 8 inputs: Tape Head; G.E. Phono; Pickering Phono; Ceramic; Microphone; Auxiliary; Tape Preamp; Tuner. Level adjustment for tuner input. Includes separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output; 2 extra AC outlets. You get every advanced hi-fi feature in this easy-to-build preamplifier at the lowest possible cost. Includes beautiful custom-styled French-gray case, with tapered chrome-finished legs, 4 x 13 x 8". With all parts, tubes, step-by-step instructions; ready for easy assembly. Shpg. wt., 12½ lbs.

Model Y-754. Hi-Fi Preamp Kit. Net only.....**$39.95**

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- Hi-Fi Response, ± 0.5 db, 10 to 120,000 cps
- Only 0.15% Distortion at 30 Watts Output
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- Chrome-Plated Chassis
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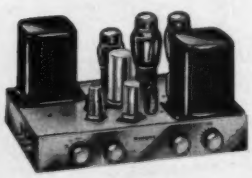
Model Y-755. 25-Watt Amplifier Kit. Net only.....**$44.50**
Y-759. Metal Cover for above; black finish. 5 lbs. Net.....**$4.25**



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Model Y-750. Net only..**$35.75**
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knight-kit 2-Way Hi-Fi Speaker System Kit

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- Easy to Assemble—Pre-Finished Enclosure
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- 12" Woofer and Horn-Type Tweeter
- A Wonderful Money-Saving Speaker Value

BIG SAVINGS—assemble your own quality KNIGHT-KIT 2-way speaker system—it's quick and easy! The cabinet is *pre-finished* in full-grained, high luster blonde or mahogany—you just assemble 7 pieces, mount the speaker components and enjoy rich, thrilling hi-fi sound—at incomparably low cost. Special Jensen-engineered baffle features "ducted port" construction to bring out the full beauty of bass notes, perfectly matching the Jensen woofer and compression tweeter; genuine L-pad control is rear-mounted to permit adjustment of tweeter for best tonal balance. Impedance, 16 ohms. The assembled unit delivers a frequency response of 45 to 14,000 cps. Enclosure measures 26 x 19 x 14". Beautifully styled to blend in any room. Kit includes Jensen 12" woofer, Jensen compression-type tweeter, pre-finished wood parts (with grille cloth installed), acoustic material, glue, hardware and step-by-step instructions. Absolutely no furniture finishing required. *Specify blonde or mahogany finish when ordering.* Shpg. wt., 33 lbs.

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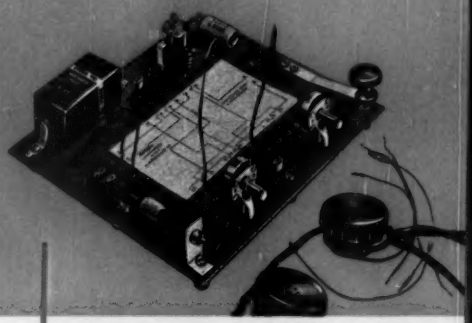

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- Built-In Loop Antenna
- Complete Kit—Nothing Else To Buy

It's fun to build this pocket-size two-transistor radio—and you'll enjoy its crystal-clear local broadcast-band reception wherever you go! Fits in your pocket, or with its button-down flap, can be worn from your belt. Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides crystal-clear tone. Handsome tan carrying case, plastic-impregnated, is styled to resemble leather; only 4x3¾x1¾". Kit includes all parts, transistors, earpiece, battery and case. Shpg. wt., 1½ lbs.

Model Y-262. Net only **$14.65**

knight-kit "Trans-Midge" Transistor Receiver Kit

Model Y-767 $2.45

Tiny, cigarette-pack-size one-transistor radio kit—fascinating to build—so low-priced. This novel miniature receiver will provide endless listening pleasure the moment assembly is completed. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Special features include: Efficient, slug-tuned coil for excellent station separation; external knob for easy station tuning; low-drain transistor operating for months from single penlight cell supplied; hinged-back, red plastic case. Kit includes all parts, transistor, battery, compact case and easy-to-follow instructions for quick assembly. (External antenna and headphones required.) Shpg. wt., 8 oz.

Model Y-767. Net only **$2.45**
J-149. 4000 Ohm Headphones. 1 lb. ... **$2.15**
C-100. Antenna Kit. 1½ lbs. **$1.03**

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Sensational experimenters' transistor kit—an electronic marvel! Perfect for experimenter, student or hobbyist. Assemble basic parts once, then complete project after project (10 in all), by simply plugging leads into proper jacks on printed circuit board—no wiring changes needed. You learn how transistors operate by "plugging in" to make any one of the following circuits; AM radio for strong headphone reception; 2-stage audio amplifier; wireless broadcaster; code practice oscillator; electronic timer; electronic switch; electronic flasher; photoelectronic relay; voice-operated relay; capacity-operated relay. Includes all parts, 2 transistors, battery, headphones, circuit leads, relay, photocell, special guide cards for each project, explanation of each circuit. 3 lbs.

Model Y-299. Net only **$15.75**

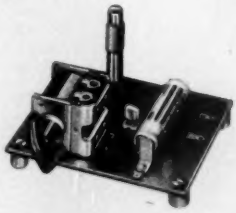
knight-kit 5-Transistor Superhet Personal Portable Radio Kit

Model Y-766 $29.95

- Styled to Equal the Finest
- Push-Pull Audio Drives 3¼" Speaker
- Printed Circuit for Easy Building
- 200 Hour Battery Playing Life

Beautiful, easy-to-build transistorized personal portable with every ultra-modern design feature: 5 Texas Instrument Co. transistors; latest printed circuit chassis for easy, error-free assembly; bigger-than-average 3½" speaker; class B push-pull audio output; built-in high-gain ferrite loopstick antenna; plus phone jack output for private listening. Provides sensitive reception of the AM broadcast band with exceptional tone quality. Ultra-smart high-impact ivory plastic case has handsome gold trim with ebony accents; includes pull-out handle; only 7½x3¾x1¾". With all parts, transistors, 9 volt transistor radio battery, carrying case and instructions anyone can easily follow. Shpg. wt., 2 lbs.

Model Y-766. Net only **$29.95**



1-Transistor Radio Kit

$3.95 Offers excellent AM local broadcast headphone reception. Printed circuit board for easy assembly. Operates from single penlight cell for months. Complete with all parts, transistor and penlight cell. (Antenna and headphones required.) Shpg. wt., 1 lb.

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"10-In-One" Electronic Lab Kit

$12.65 Famous experimenters' kit. Builds any of 10 fascinating projects, including broadcast receiver, wireless phono oscillator, code practice oscillator, signal tracer, relays, etc. Shpg. wt., 5 lbs.

Model Y-265. Net only **$12.65**

"6-In-One" Electronic Lab Kit

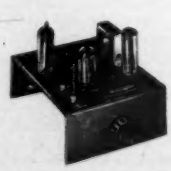
$8.45 A favorite with beginners. After basic wiring is completed, you make circuit changes without soldering. Builds any of six favorite projects, including radio, wireless broadcaster, etc. Shpg. wt., 3 lbs.

Model Y-770. Net only **$8.45**

Crystal Set Hobby Kit

$2.15 Entertaining, educational. Delivers clear headphone reception of local broadcast stations. With all parts, ready for easy assembly. (Antenna and headphones required.) Shpg. wt., 1 lb.

Model Y-261. Net only **$2.15**



Wireless Broadcaster Kit

$9.50 Play music or make announcements through your radio set—no connection to set required! Loads of fun—easy to build. Works up to 50 feet from set. Shpg. wt., 3 lbs.

Model Y-705. Net only **$9.50**

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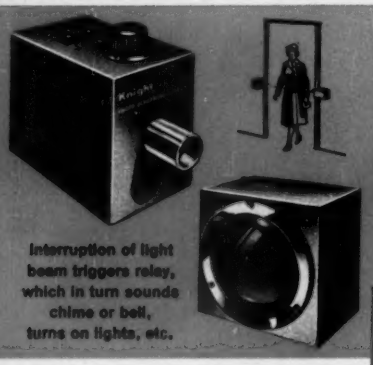


Interruption of light beam triggers relay, which in turn sounds chime or bell, turns on lights, etc.

knight-kit Photoelectronic Relay Kit

Model Y-702 $13.50

Advanced-design, ultra-sensitive photoelectronic relay—build it yourself and save! Dozens of uses: for automatic control of lights, door announcer, burglar alarm, counting devices, etc. Provides dependable operation up to 250 feet with white light, up to 125 feet with "unseen" light (red filter) from Light Source Kit listed below. Selectable operation, with "trip" for burglar alarm to provide continuous ringing of alarm; and "auto" if relay is to operate each time beam is broken (for chimes, counting devices, turning on lights at darkness). Has SPST relay operated from thyratron; 6.3 v. terminals provide power for accessories. For 105-120 v. 50-60 cy. AC use. 6 lbs.

Model Y-702. Relay Kit. Net only . . **$13.50**

Model Y-703. Light Source Kit. With bulb and red filter. Shpg. wt., 3½ lbs. Net. **$6.75**

knight-kit "Ocean Hopper" All-Wave Radio Kit

Model Y-740 $11.95

This top-performing regenerative receiver puts a world of listening pleasure at your finger-tips. Tuning range (using coils listed below) is virtually world-wide; covers 155 kc to 35 mc, including every type of radio transmission: AM broadcast, marine, aircraft, distress channels, direction-finding, Amateur, frequency standard, foreign broadcast, and police. With bandspread tuning. For use with headphones or 3-4 ohm PM speaker. Kit is supplied with standard broadcast band coil and all tubes and parts. (Less extra coils, headphones, speaker and cabinet.) Shpg. wt., 5 lbs.

Model Y-740. Net only **$11.95**

Y-746. Cabinet for above. 1½ lbs. Net **$2.90**

Extra coils available: Long Wave Coil (155-470 kc), Net 79c. Short Wave (1.65—4.1 mc; 2.9—7.3 mc; 7—17.5 mc and 15.5—35 mc), Each 65c.

knight-kit "Space-Spanner" Bandswitching World-Wide Radio Kit

Model Y-243 $15.95

- Broadcast or Short Wave Reception
- Sensitive Regenerative Circuit
- Convenient Bandspread Tuning
- Built-In Loudspeaker

Imagine the thrill of hearing overseas broadcasts on a precision receiver you've built yourself—and then, at the flip of a switch, being able to tune to your favorite local broadcast station! Bandswitch selects exciting short wave, including foreign broadcasts, amateur calls, aircraft, police and marine radio on the 6.5 to 17 mc range, as well as standard 540-1700 kc broadcasts. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power tube for strong volume and clear tone. Headphone connectors are available for private listening; switch cuts out speaker. Controls: Bandspread, Main Tuning, Antenna Trimmer, Bandswitch, Regeneration, Volume. 7x10x6". Easy to build from step-by-step instruction manual. For 110-120 v., 50-60 cy. AC or DC. (Less cabinet.) Shpg. wt., 5 lbs.

Model Y-243. Net only **$15.95**

Y-247. Cabinet for above. Shpg. wt. 2 lbs. Net. **$2.90**

"Ranger II" Superhet Receiver Kit

$17.25 Popular Broadcast band receiver built and enjoyed by thousands. Features built-in antenna, automatic volume control, ball-bearing tuning condenser, PM dynamic speaker. Handsome plastic cabinet. Easy to assemble. AC or DC operation. Shpg. wt., 8 lbs.

Model Y-735. Net only **$17.25**

knight-kit 2-Way Intercom System Kit

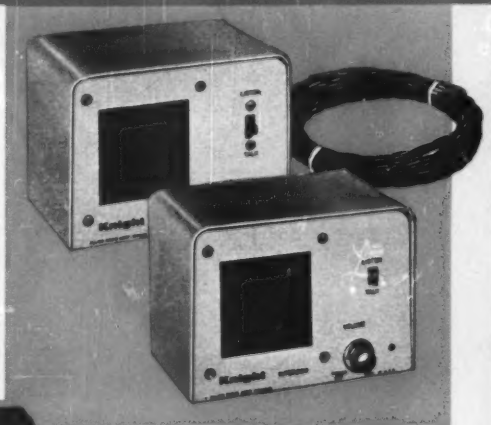
Model Y-295 $14.75

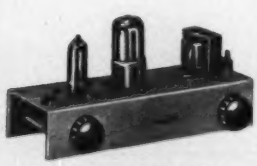
- Low Cost—Easy to Assemble
- High Gain—Clear Tone
- Handsome Metal Cabinets
- Includes 50-Foot Cable

Easy to build at lowest cost—ideal for home, office, shop or school. Consists of Master unit and Remote unit. Remote unit may be left "open" for answering calls from a distance, for "baby sitting", etc. Remote also may be set for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier, combination volume control and on-off switch, plus pilot light. Each unit has 4" PM dynamic speaker. System responds to even a whisper. Handsome Antique white cabinets, each 4¾x6½x4¾". With all parts, tubes and 50-ft. cable (up to 200-ft. may be added). For 110-120 v., AC or DC. 8 lbs.

Model Y-295. Master and one Remote. Net only . . **$14.75**

Y-296. Extra Remote Station Kit. 3 lbs. **$3.75**





Phono Amplifier Kit

$9.45 Build it yourself—and save! Ideal for use in a portable phonograph—just add record player and 3-4 ohm speaker. 1½ watts output. Inverse feedback circuit. Easy to assemble. Shpg. wt., 3 lbs.

Model Y-790. Net only **$9.45**

Electronic Photoflash Kit

$28.50 Ideal for color or black and white photography. 1/700th-of-a-second flash; 50 watt/second output. Synchronizes with any camera with X or O shutter. (Less battery.) Shpg. wt., 4 lbs.

Model Y-244. Net only **$28.50**

Code Practice Oscillator Kit

$3.95 Ideal for beginners learning the code. Transistorized circuit. Operates for months from single penlight cell supplied. Clear, crisp 500 cycle tone. Jacks for headphones; screw terminals for key. 1 lb.

Model Y-239. Net only **$3.95**

Phono Oscillator Kit

$5.85 "Broadcasts" recorded music through any standard radio set up to 50 feet away. No direct connection to set required. Easy to build—fun to use. Shpg. wt., 2 lbs.

Model Y-760. Net only **$5.85**

FINEST ELECTRONIC EQUIPMENT IN EASY-TO-BUILD MONEY-SAVING KIT FORM

ADVANCED-DESIGN INSTRUMENTS FOR SERVICE, INDUSTRIAL AND RESEARCH USE

IN EASIEST TO BUILD, MONEY SAVING KIT FORM

Better By Far— ALLIED knight-kit QUALITY TEST INSTRUMENTS

knight-kit Low-Cost Tube Tester Kit

Model Y-143 $29.75

- With 16 Filament Voltages
- 600 Latest Tube Types Listed
- Easy-to-Read 4½" Meter
- Tests Series-String TV Tubes

Expertly designed for complete, up-to-date coverage of tube types. Tests *series-string TV tubes;* tests 4, 5, 6 and 7 pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. Tests for open, short, leakage, heater continuity and performance (by amount of cathode emission). Big 4½" square meter has clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 16 filament voltages from 0.63 to 117 volts to check virtually all receiving tubes; blank socket for future type tubes. Universal-type selector switches permit selection of any combination of pin connections. Single-unit, pre-assembled 10-lever function switch simplifies and speeds assembly. Up-to-date illuminated roll chart lists over 600 tube types. Counter model case, 5 x 14 x 10". Easy to build. 14 lbs.

Model Y-143. Net only **$29.75**

Y-142. Portable Case model. 15 lbs. Net **$34.75**

Y-141. Picture Tube Adapter. 1 lb. Net ..... **$ 4.25**

knight-kit RF Signal Generator Kit

Model Y-145 $19.75

Build this wide-range, extremely stable RF signal generator—save two-thirds the cost of a comparable wired instrument! Large, semi-circular dial is clearly calibrated; range is covered in 5 separate bands for close accuracy in setting individual frequencies. Ideal for aligning RF and IF stages in radio and TV sets and for troubleshooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 112 mc; useful harmonics to 224 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit. Convenient jack for external modulation. Maximum audio output 10 volts; RF output over 0.1 volt on all ranges. Step and continuous-type attenuator controls. Supplied with precision-wound coils that require no adjustment. 7 x 10 x 5". Shpg. wt., 11 lbs.

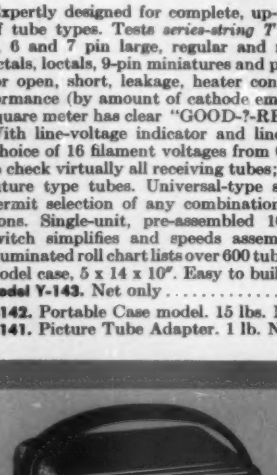
Model Y-145. Net only **$19.75**

knight-kit 1000 Ohms/Volt VOM Kit

Model Y-128 $16.95

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab or Amateur use. Large 4½", 400 microamp meter with separate scales for AC and DC voltage and current, decibels and resistance. *Uses 1% precision resistors;* has 3-position function switch and 12-position range switch. *38 ranges* include: AC, DC and output volts, 0-1-5-10-50-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg (center scale readings of 60, 150 and 1500 ohms); Current, AC or DC, 0-1-10-100 ma and 0-1 amp; Decibels, −20 to +69 in 6 ranges. Precision resistors are used as shunts and multipliers to assure exceptional accuracy of measurements. With all parts, battery, test leads and black bakelite case with convenient carrying handle, 6¾ x 5¼ x 3¾". A great value in an easy-to-build quality instrument. Shpg. wt., 2½ lbs.

Model Y-128. Net only **$16.95**



knight-kit Vacuum Tube Voltmeter Kit

Model Y-125 $24.95

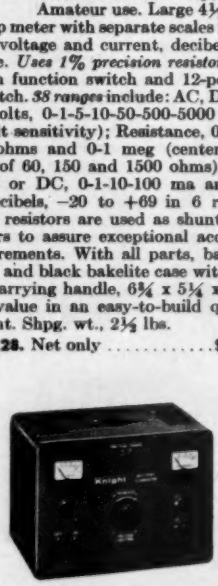
- 200 μa Movement, 4½" Meter
- Includes AC, Peak-to-Peak
- Balanced-Bridge, Push-Pull Circuit
- 1% Film-Type Resistors

Top buy in an extremely stable, highly accurate VTVM. Easy to assemble—entire chassis is printed circuit board. Perfect for radio-TV service work, lab and Amateur use. Features low-leakage type switches; 1% film-type precision resistors; balanced-bridge, push-pull circuit (switch to any range without readjusting zero set); zero center scale and direct-reading db scale; polarity reversing switch. Ranges: Input Resistance, 11 megs; DC and AC rms, 0-1.5-5-15-50-150-500-1500; AC Peak-to-Peak, 0-4-14-40-140-1400-4000; Response, 30 cycles to 3 mc; Ohms, 0-1000-10K-100K and 0-1-10-100-1000 megs; db, −10 to +5. Includes all parts, tubes, battery, test leads and portable case, 7¾ x 5¼ x 4-7/16". Easy to assemble. Shpg. wt., 6 lbs.

Model Y-125. Net only **$24.95**

Y-126. Hi Voltage Probe; extends DC to 50,000 v. ..... **$ 4.75**

Y-127. Hi-Frequency Probe; extends AC to 250 mc. ..... **$ 3.45**



6V-12V Battery Eliminator Kit

$32.95 High current rating; continuously variable filtered output; delivers 15 amps at 6 volts, 10 amps at 12 volts. May be used as battery charger. Two meters provide simultaneous current and voltage readings. Shpg. wt., 18 lbs.

Model Y-129. Net only **$32.95**

Transistor Checker Kit

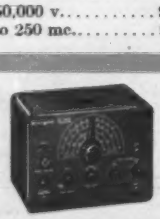
$8.50 Checks gain ratio of all types of transistors; checks germanium and silicon diodes; checks for continuity and shorts. A valuable instrument at very low cost. Easy to assemble. Shpg. wt., 2½ lbs.

Model Y-149. Net only **$8.50**

Flyback Checker Kit

$19.50 Checks condition of all types of horisontal output transformers and deflection yokes, as well as TV linearity and width coils. 4½" meter; widest range in its field. Shpg. wt., 6 lbs.

Model Y-118. Net only **$19.50**



Sweep Generator Kit

$43.75 Extreme linearity on a par with costly lab instruments; fundamentals to 250 mc; output flat within 1 db; electronic blanking. Easy, money-saving assembly. Shpg. wt., 16 lbs.

Model Y-123. Net only **$43.75**

Capacitor Checker Kit

$12.50 Tests capacitors while in the circuit! Has widest range—20 mmf to 2000 mfd. Exclusive circuit for cancelling lead capacity. "Magic Eye" indicator. Save 60% over factory-wired units. 5 lbs.

Model Y-119. Net only **$12.50**

knight-kits FOR THE RADIO AMATEUR

ADVANCED-DESIGN INSTRUMENTS FOR SERVICE, INDUSTRIAL AND RESEARCH USE IN EASIEST-TO-BUILD, MONEY-SAVING KIT FORM

knight-kit 20,000 Ohms/Volt VOM Kit

Model Y-140 $29.50

Outstanding quality and performance at money-saving low price. Features 1% precision multipliers; 4½" meter accurate within 2% of full scale deflection; 50 microamp sensitivity for 20,000 ohms/volt input resistance on DC; front panel "Zero adjust"; single switch to select function and range. 32 ranges: AC, DC and output volts, 0-2.5-10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-0.1-10-100; DC amps, 0-1-10; Decibels, −30 to +63 in six ranges. Moisture-resistant film-type resistors for extreme accuracy. Carefully engineered circuit design achieves high sensitivity and extremely versatile application. Kit includes all parts, battery, test leads and black bakelite case with highly legible white markings; size 6¾ x 5¼ x 3¾". Easy to assemble. Shpg. wt., 5 lbs.

Model Y-140. Net only.....**$29.50**

knight-kit High-Gain Signal Tracer Kit

Model Y-135 $26.50

A remarkable value in an easy-to-build instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits. Has *highest gain in its price class.* Traces signal from antenna to speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of *91,000;* "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; combination 2-position probe, one for RF (6 mmf. input), the other for audio. Provides noise test; built-in watt-meter calibrated from 25 to *1000 watts;* provision for external scope or VTVM. Binding posts provide output transformer and speaker substitution test, plus external 280 volts B+. With all parts, tubes and probe. 7x10x5". 12 lbs.

Model Y-135. Net only.....**$26.50**

knight-kit 5" Wide-Band Oscilloscope Kit

Model Y-144 $69.00

- 5 mc Width for Color TV
- Horizontal Sweep to 600 kc
- 25 mv/inch Sensitivity
- Z-Axis Input
- Printed Circuit Construction

Only $6.90 down

Equals or betters the performance of commercially wired scopes costing far more. Two printed circuit boards and laced wiring harness assure wiring accuracy and cut assembly time. Ideal for lab use, color TV servicing and high frequency applications. Wide sweep range—*15 to 600,000 cps.* Vertical response, ± 3 db, 5 cps to 5 mc; only 1 db down at 3.58 mc color burst. High vertical sensitivity of .025 rms v/inch. Input capacity, 20 mmf. Outstanding features: cathode follower inputs; 2nd anode provides 1400 volts high-intensity trace; push-pull amplifiers; positive and negative locking; frequency-compensated attenuator; Z-axis input; one volt P-P calibrating voltage; astigmatism control; retrace blanking circuit; DC positioning control. Includes CRT. 14½ x 9½ x 16". 40 lbs.

Model Y-144. Net only.....**$69.00**
Y-148. Demodulator Probe. Net.....**$ 3.45**
Y-147. Low Capacity Probe. 12 mmf. Net....**$ 3.45**

Voltage Calibrator Kit

$12.75

Permits use of any scope as precision peak-to-peak AC voltmeter. Puts a true square-wave voltage on scope screen. Selects any voltage between .01 and 100 volts; feeds external signal direct to scope for instant comparison. Shpg. wt., 5 lbs.

Model Y-136. Net only.....**$12.75**

knight-kit 5" General-Purpose Scope Kit

Model Y-146 $42.00

- Phantastron Linear Sweep
- 25 mv/inch Sensitivity
- Printed Circuit Board
- Retrace Blanking Circuit

Only $4.20 down

Feature for feature the world's best oscilloscope kit value. A standout in its class with all these fine features: *Printed Circuit* wiring board and laced harness for quick, error-free assembly. *Phantastron Sweep Circuit* for high linearity of sweep from 15 to 150,000 cps. *25 Millivolts Per Inch Sensitivity*—3 times that of similarly priced scope kits. *Calibration Voltage*—1 volt peak-to-peak square wave, fully regulated. *Vertical Amplifier*—frequency response ± 3 db, 3 cps to 1.5 mc (± 6 db to 2.5 mc). Includes: Directly coupled positioning controls; retrace blanking circuit; frequency-compensated vertical input attenuator; positive and negative internal sync; high 2nd-anode voltage for high-intensity trace; input capacity, 45 mmf. Kit includes CRT. 9½ x 13¾ x 17¾". 26 lbs.

Model Y-146. Net only.....**$42.00**

Resistance Substitution Box

$5.95

Easily determines resistor values required in a circuit. Makes available 36 standard 1-watt resistance values in 2 ranges between 15 ohms and 10 megohms, with 10% accuracy. Slide switch selects range; 18-position switch for value selection. Shpg. wt., 2 lbs.

Model Y-139. Net only.....**$ 5.95**

Capacitance Substitution Box

$5.95

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard values from .0001 mfd to .22 mfd, ± 20%. All values are 600 volt, except .15 and .22, which are 400 volt. 18-position selector switch. Shpg. wt., 2 lbs.

Model Y-138. Net only.....**$ 5.95**

Audio Generator Kit

$31.50

Excellent design; range, 20 cps to 1 mc; less than .25% distortion; 600 ohm output. Ideal for hi-fi testing; offers the flat response of a lab standard. Shpg. wt., 16 lbs.

Model Y-137. Net only.....**$31.50**

R/C Tester Kit

$19.50

Measures capacitance and resistance. Balanced-bridge circuit; indicates power factor; tests capacitors at rated voltage. Large, easy-to-read dial and "magic eye." Shpg. wt., 10 lbs.

Model Y-124. Net only.....**$19.50**

EASY TERMS AVAILABLE Take advantage of the most liberal Easy Pay plan in electronics. On Knight-Kit orders totaling $45 or more—just 10% down, small monthly payments thereafter. Low carrying charges—no "red tape."

knight-kits FOR THE RADIO AMATEUR

knight-kit All-Band Amateur Receiver Kit

Model Y-726

$104.50

Only $10.45 down

- Tunes 540 kc to 31 mc
- Built-in Q-Multiplier
- Constant Running HF Oscillator
- Worthy of the Advanced Ham Operator
- Printed Circuit Bandswitch
- Printed Circuit Board
- 1.5 μv Sensitivity

A sensational communications receiver value with all the selectivity, sensitivity and features of high-priced commercial units. Uses printed circuitry throughout, including the exclusive new KNIGHT-KIT printed circuit bandswitch, for remarkably easy assembly. Covers 540 kc to 31 mc in 4 ranges; calibrated, electrical bandspread on 80-10 meter Ham bands; slug-tuned Hi-Q coils; continuous, VR tube-regulated B+ applied to HF oscillator lets you switch from standby to receive with no drift; built-in Q-multiplier peaks desired signal or nulls interference; delayed AVC; provision for crystal calibrator (below). Sensitivity, 1.5 microvolts for 10 db signal-to-noise ratio. Selectivity: variable from 300 cps to 4.5 kc at 6 db down. Exalted BFO injection. Controls: Main tuning, bandspread, band selector, Q-multiplier selectivity, Q-multiplier tune, null-off-peak, BFO pitch, RF gain, AF gain, BFO-MVC-AVC-ANL, off-stby-rec-cal, antenna trimmer, and phone jack. Cold-rolled 1/16" steel chassis. Handsome metal cabinet, 10 x 10 x 16½". (Less phones, 8-ohm loudspeaker and S-meter.) 23 lbs.

Model Y-726. Amateur Receiver Kit. Net..... **$104.50**

Y-727. S-Meter Kit for above. 1 lb. Net..... **$9.50**

knight-kit 50-Watt CW Transmitter Kit

Model Y-255

$38.95

Only $3.89 down

- Ideal for the Novice
- Pi Antenna Coupler
- Bandswitching—80 to 10 Meters

There's exceptional value in this very popular bandswitching transmitter kit. Compact and versatile, it's the perfect low-power rig for the beginning novice as well as the seasoned veteran. Has bandswitching coverage of 80, 40, 20, 15 and 10 meters. Rated at 50 watts—actually operates at up to 60 watts on 80 and 40 meters. Oscillator is efficient 6AG7; final is reliable 807. Crisp, clean, cathode keying of oscillator and final. Built-in pi coupler permits use with random length antennas. Has highly effective TVI suppression. Other features not usually found in transmitter kits at this low price include: Ceramic-insulated final tank capacitor; pre-assembled switches; pre-wound parasitic chokes; ceramic coil forms; coax connector; crystal and VFO socket on front panel; power take-off jack for accessory equipment. Meter reads either plate or grid current of final. Takes crystal or VFO without circuit changes. Cabinet interior and chassis are copper-finished. Size, 8⅛ x 10⅛ x 8¼". With tubes and all parts for easy assembly. (Less crystal and key.) Shpg. wt., 19 lbs.

Model Y-255. 50-Watt Transmitter Kit. Net only..... **$38.95**

knight-kit Self-Powered VFO Kit

Model Y-725

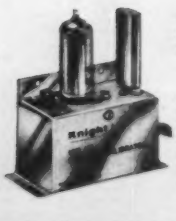
$28.50

Only $2.85 down

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread; separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output: 40v on 80, 20v on 40. With Spot-Off-Transmit switch for spot frequency tuning. Extra switch contacts for operating relays and other equipment. Attractive metal cabinet, 8¾ x 6 x 6". Ready for easy assembly. Shpg. wt., 8 lbs.

Model Y-725. VFO Kit. Net only..... **$28.50**

knight-kit 100 Kc Crystal Calibrator Kit



Model Y-256 **$10.50**

Crystal frequency standard at very low cost. Gives marker every 100 kc up to 32 mc. A "must" for marking band edges. Mounting flanges for installation in or back of receiver cabinet. Size only 1½x 1⅝x3". Requires 6.3 v. at 0.15 amp and 150-300 v. DC at 3-6 ma. Trimmer for zero-beating with WWV; On-Off switch. Complete with tube, crystal, all parts and easy-to-follow instructions. Shpg. wt., 1 lb.

Model Y-256. 100 Kc Crystal Calibrator Kit. Net only..... **$10.50**

Model Y-253

$5.85

knight-kit Amateur RF "Z" Bridge Kit

Measures standing wave ratio (SWR) and impedance of antenna systems; ideal for adjusting antenna systems for optimum results. Measures impedances from 20 to 400 ohms up to 100 mc; SWR to 150 mc. Any VOM may be used for null indicator. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticized SWR chart (less meter). 2½ x 3 x 4⅛". Shpg. wt., 1⅛ lbs.

Model Y-253. "Z" Bridge Kit. Net only..... **$5.85**

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ALLIED RADIO, Dept. RE, 100 N. Western Ave., Chicago 80, Ill.

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☐ My Down Payment in the amount of $..... is enclosed. Send Time Payment form.

Name.....

Address.....

City.....Zone.....State .....

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Service Industry News

THE FIRST issue of the new house organ titled *"Television Progress,"* the official journal of the American Institute of Television, Detroit, Mich., points up an interesting by-product of licensing. This by-product is the critical self-policing of the industry which the license law generates, particularly with respect to the manner in which the provisions of the law are applied.

The Detroit licensing ordinance was passed by the Common Council of that city after an aggressive campaign conducted primarily by the Television Service Association of Michigan with the support of the local Better Business Bureau and law enforcement agencies. A former president of TSA was appointed as a member of the Television Board of Examiners, the agency established to administer the ordinance.

There are four separate associations in Detroit all of which are directly concerned with electronic service. Two of these organizations, the Television Service Association of Michigan and the American Institute of Television, are composed of service dealers. The other two, the Television Technicians Association and the Television Technician's Guild, are primarily technical organizations.

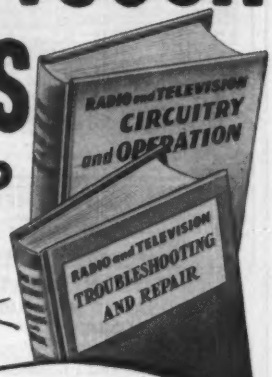
According to *"Television Progress,"* one of the regulations set up by the Board of Examiners requires that all Service Dealers' License Applications must contain the following sworn statement, "I will not permit the use of my license by any other firms or persons."

The purpose of such a provision, as indicated in the many discussions among service dealers about the provisions that should be incorporated in any license law, is to prevent the establishment of two or more separate businesses operating under a single license but each functioning under different standards of ethical business practices.

Such a regulation, however, also affects TV service contractors who handle warranty service for department stores and major dealers. Where service is handled by the contractor in the name of the dealer, all service orders, invoices, etc., must carry the name of the retailer. Where multiple identity is prohibited by law or regulation, separate licenses must be obtained by the service contractor for each account he handles. This, of course, poses some serious problems where the law stipulates the supervisory and technical personnel requirements of dealer licensees.

HANDLE THE TOUGH SERVICE JOBS

AS SLICK AS YOU DO THE EASY ONES . . .



This famous Ghirardi Service Library shows you how to

HANDLE *ANY* JOB EASIER, BETTER and lots faster.

COMBINATION OFFER
SAVE $1.25
Almost 1500 pages of modern service training for only $13.00
3 MONTHS TO PAY

These two giant how-to-do-it Ghirardi manuals make it easy for you to be an expert on all types of Radio-TV receiver service . . . *at only a fraction of the price you might expect to pay.* From tough realignment jobs to tracking down "intermittents" . . . from analyzing response curves to "static" and "dynamic" test procedures, these books explain every step clearly as A-B-C. They point out time-saving short cuts and help you work better, more profitably! Use coupon. Practice from them 10 days AT OUR RISK!

1 COMPLETE *Professional* TRAINING IN MODERN SERVICE METHODS

Radio and Television TROUBLESHOOTING AND REPAIR gets right down to earth in guiding you through each service procedure . . . from locating troubles quickly to fixing them fast and right.

For beginners, this famous 822-page book is an absolutely complete training course in professional methods. For experienced servicemen, it is the ideal way to develop better troubleshooting methods and shortcuts, to find quick answers to puzzling problems and to handle tough jobs faster.

Block diagrams, oscilloscope patterns, response curves and other features speed your work . . . make each step doubly clear. Handy troubleshooting charts cover practically every type of job from troubleshooting television to AM and FM realignment, IF and Detector sections, car radios and many more.

Here are a few of the subjects covered in Radio and TV Troubleshooting and Repair: Component Troubles; Basic Troubleshooting Methods; Shortcuts, Tips and Ideas; Complete Guide to TV Service; Realignment Made Easy; FM, Communications Receivers, Record Players, etc.; Auto Radios; Loudspeakers; Tuner and Switching Mechanisms; and dozens more. 417 clear illustrations. Price only $7.50 separately. See MONEY-SAVING OFFER in coupon.

2 *Learn all about circuits* . . . AND WATCH SERVICE HEADACHES DISAPPEAR!

You can repair any radio or TV set . . . even special electronic equipment far better and faster when you know all about its circuits! That's where this 669-page Radio & TV CIRCUITRY AND OPERATION is worth its weight in gold.

You locate troubles in far less time . . . *because circuitry "know-how" teaches you exactly what to look for and where.* You make repairs better and faster . . . *because you eliminate useless testing and guesswork.*

Radio & TV CIRCUITRY AND OPERATION deals fully with practically every circuit and circuit variation used in modern receivers. It teaches you their peculiarities and likely trouble spots. Over 110 pages explain Television . . . from scanning to signal to every circuit detail of each of the receiver sections.

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In Detroit, the American Institute of Television questioned the legality of one service contractor's use of his license number for his own business and also on the invoices of one of the dealers for whom he handles service. Since this contractor is a member of the Television Board of Examiners, the incident may bring about some serious misgivings on the part of political authorities over the wisdom of appointing men to serve on a license-governing board who are directly involved in the activity that is licensed.

Manufacturer-Service Angle

A new company recently incorporated to operate in Michigan is intended to provide warranty service facilities to TV manufacturers who do not operate their own service outlets. Chartered as the Telectro Service Associates, Inc., participation in it is restricted to service dealers who are members of the Television Service Association of Michigan.

The new corporation is reported to have closed a deal with *Philco* whereby they will take over all warranty service on *Philco* TV sets sold in the greater Detroit area. It is said they are also dealing with other TV manufacturers to handle their warranty service in the same area.

It is claimed that the plan of the new type of service corporation will provide distinct advantages both to the participating manufacturers and the independent service industry. The TV manufacturer is provided with the facilities, management, and technical know-how of some of the best service companies in the metropolitan area. Since these shops are widely dispersed over the area, they will be able to provide prompt service more economically and efficiently than it could be given from a single, central depot. Although a score or more shops may participate in the service company in a large metropolitan area, the TV manufacturer is required to deal with but one organization, which is the operating corporation.

The advantage to the independent service industry, it is claimed, is that control of consumer service will remain in the hands of independent shops.

New Groups and Officers

The Radio & Television Service Association of Durham, North Carolina, was recently organized by service firms in that area. Officers elected to guide the new association included Charles McBroom of *Mack's TV Service,* as president; Garland Hoke, of *Hoke TV & Radio Service,* vice-president; L. L. Leathers, *Leather's TV Service,* secretary; and Walter Cobb, *Cobb's Television,* treasurer.

The organization will attempt to "promote better understanding between the serviceman and the public," promote a code of ethics that will include honest advertising, fair pricing controls, and conscientious service.

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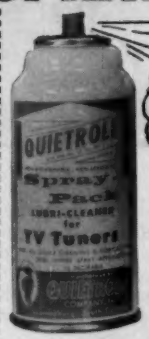

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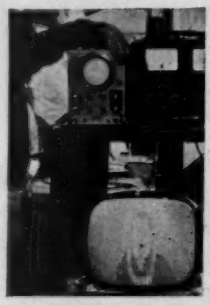

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The organization plans to sponsor a service training program.

Wally Hirschberg, head of *Hirschberg Television Technicians,* was recently elected president of the Television Electronic Service Association of St. Louis.

Other newly elected officers who were installed at their annual meeting early in July, are Ralph Newberry, *Southampton Electronics Co.,* executive vice-president; Harry Haus, *Jennings TV Service,* first vice-president; Ray Wirtel, *Wellston Electronics, Inc.,* second vice-president; Fred Reichman, *Teltronic Laboratories,* secretary; Robert Matteson, *Matteson Radio & TV,* treasurer; and Charles Luensman, *Calco Electronics,* sergeant-at-arms.

Seven directors were named to serve on the Board with the chairman, immediate past president Barney Lewis of *Lewis Radio & Television.* These include Howard Freiner, *Empire Television Service Corp.;* Walter Berganti, *Qualified Television Service;* Vincent J. Lutz, *Lutz Radio & Television;* Tom Knowles, *Knowles Television & Radio;* J. G. Alexander, *Alexander Radio & Television Service, Inc.;* Russ Adelman, *Associated Television Service,* and Nick Koclaines, *Midwest Television Service.*

The Electronic Technicians' Association of northern Illinois was recently organized by service dealers and technicians in Rockford, Ill. The new organization has about eighty members.

William R. Mosley of *Mosley's TV* was elected president of the new Illinois association. Three vice-presidents were named to serve with him. These include Ray Dumas of *C. E. T.;* Gene Leander of *Leander TV & Appliances;* and Robert Stromeyer of *Mosley's TV.* The association will meet the last Thursday of each month.

The Ohio State Association of service organizations met recently in Columbus to gauge the interest in continuing its efforts. Originally formed late in 1955 under the name TESA of Ohio, the organization had been dormant until the recent meeting.

Consensus of the local association officers who attended the Columbus meeting was that there is sufficient interest throughout the state to warrant the scheduling of regular meetings.

More on Licensing

State-wide licensing bills all died in committee in the several states where they had been presented by sponsors for consideration during 1957 legislative sessions. The most widely publicized were the license measures introduced in Missouri, Illinois, and California. Many pro-licensing service dealers in the Midwest were critical of the provisions included in the license laws proposed for Missouri and Illinois. They felt that these measures were so restrictive that they would be declared unconstitutional even if they were passed by the respective legislatures.

-30-

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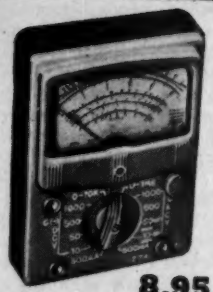

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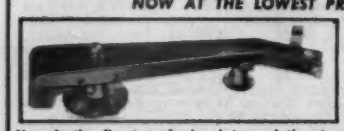

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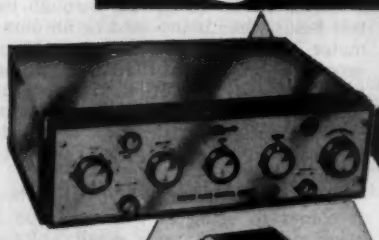

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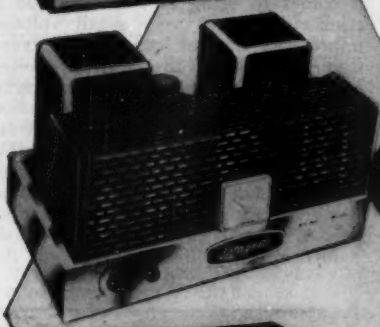

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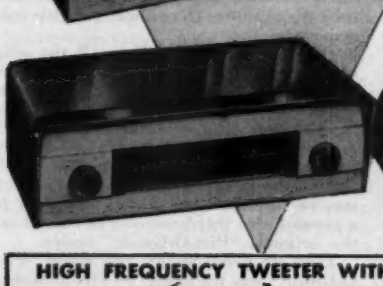
ML-100—Metal Cage for above. Shpg. wt., 3 lbs. ..... Net **5.00**



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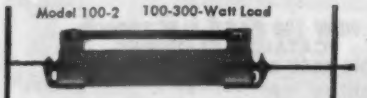

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Mac's Service Shop

(Continued from page 72)

at the waveshape what is causing the hum.

"If you keep the brightness high, a scope is also fine for spotting the exact point where a scratching, rustling noise, such as that produced by a bad winding in an i.f. transformer or oscillator coil, originates. The noise will show up as sharp little spikes on the trace. If the brightness is too low, these will not be seen."

"I'd think the signal tracer would be handy for that, too."

"It is in many cases. Usually a signal tracer is not too good for running down 60-cycle hum for many of these units are deliberately designed not to respond to these low frequencies. In such a case, the scope should be used. But the tracer is fine for running down whistles, scratching sounds, etc."

"Every now and then I see you grab up the grid-dip oscillator. What do you use that for?"

"Well, it's mighty handy for determining if an i.f. transformer winding will resonate on the frequency it is supposed to. You know some of these slug-tuned jobs have small capacitors molded right into the transformer and now and then one of these little capacitors will go bad. When that happens, the associated coil will not tune to the i.f. frequency. The same condition sometimes prevails, though, when a plate bypass or an a.v.c. capacitor is open; so the GDO is very handy in determining if the transformer itself is at fault. It is also very useful in seeing if a tuned circuit is tracking properly. Occasionally it comes in handy for setting a wavetrap. I do not use it often; but when I do need it, hardly anything else will take its place."

"As I get the picture," Barney summarized, "you think that there is one best instrument for doing every job and you try to select that instrument as you tackle each set."

"That's about it. I don't want to leave the impression that the trouble could not be found eventually through the use of one of the other instruments. Such is not the case at all. It's simply a matter of which instrument will permit you to find the difficulty with the least expenditure of time and trouble. Many times it will be necessary to switch from one instrument to another as the trouble is cornered in smaller and smaller portions of the circuit. Never hesitate to make such a change when it is indicated. Remember how Sherlock Holmes used information from his Baker Street Irregulars, his sensitive trained nose, and finally his powerful magnifying glass in tracking down a criminal. It's well to follow his example. By using first one method and then another in troubleshooting, all of these techniques are maintained as shining tools in your mental kit, ready for instant use."

"The thought occurs to me that there are a few instances where certain instruments should not be used," Barney offered. "For example, a v.t.v.m. is usually thrown off calibration in the presence of a strong r.f. field; so it is not dependable when working around a powerful on-the-air transmitter. Checks can usually be made with it when the transmitter is working into a dummy antenna, but all-in-all a good v.o.m. is usually preferable for transmitter work."

"Right you are," Mac agreed. "By the same token, a v.t.v.m. or v.o.m. that has a high current of a hundred milliamperes or so flowing through its test leads when being used as an ohmmeter should not be used on battery sets with low-current filaments. Doing so can easily result in burned-out tubes. Check to find out the maximum current that flows through the leads for each ohmmeter range and act accordingly.

"Extreme caution is the rule when it comes to using an ohmmeter on a transistor set. A very small voltage improperly applied can ruin a transistor. I prefer not to use an ohmmeter at all when checking these sets. Usually I can obtain the information I want by using the v.t.v.m. as a voltage-indicating instrument. When this is not the case and when the transistors cannot be readily removed from the receiver, I disconnect the component I want to check from the circuit before applying the ohmmeter to it."

—30—

FIRST COLOR "PICT-O-GUIDE"

TO ASSIST service technicians already skilled in conventional TV service to bridge the gap to color TV, the Radio Corporation of America has published the "Color Television Pict-O-Guide" a 200-page practical, step-by-step book of instructions on installing, adjusting, and servicing color receivers, generously illustrated in full color and bound in loose-leaf form. The volume is available only through authorized RCA electron tube distributors in connection with tube orders.

Old-timers in TV will recall the original "Pict-O-Guide" for monochrome TV, which first made its appearance about 10 years ago. Prepared by John R. Meagher, the original version made lavish use, in its 100 pages, of picture-tube views to aid the technician in TV troubleshooting by picture analysis. It was so popular that it was followed by a second and third volume to round out the original "Pict-O-Guide" series.

Like its predecessor, the color "Pict-O-Guide" was prepared by Mr. Meagher, who spent nearly a year at the task. Eschewing mathematics and the highly theoretical aspects of color transmission and reception, he has concentrated on the accumulation of picture-tube displays indicating various types of abnormal operation, with associated text to indicate the source of the trouble and what may be done to remedy it. RCA hopes that this approach will be as useful in facilitating the transition from monochrome to color TV service as it was in the change from radio service to monochrome TV service. —30—

Reducing Hum and Noise in Preamplifiers

By **SIDNEY TOBY**

Here is a simple procedure that the audiophile can follow which will increase his enjoyment of fine-music listening.

IF THERE is no audible hum or noise from your loudspeaker at normal listening levels, when you are sitting in your favorite armchair, then you are in luck. If not, it is worthwhile spending a little time to reduce such hum and noise.

Providing the "B+" supply is adequately filtered and the layout of components is well designed, any residual hum can usually be traced to the use of a.c. on the preamplifier tube heaters. The use of d.c. on the heaters would remedy this but the rectifiers and capacitors needed to make the changeover are relatively expensive. In any case, the voltage drop across the rectifier precludes the use of the ordinary filament winding of the power transformer and there may not be another winding available.

There are various hum reducing devices that can be used, such as placing a potentiometer tapped to ground across the heater circuit, the use of positive bias on the heaters, and so on. These methods do not usually lower the hum level by more than a few decibels and are not completely satisfactory.

A much better arrangement is obtained by heating the first stage or two with the d.c. available from the cathodes of the power output tubes. This may be done by simply putting the heaters in series with the cathode resistor as shown in the diagram, and the only prerequisite is that the current through the cathode resistor be sufficient for the heaters.

If the cathode current is unknown, and there is no jack installed from which it can be measured directly, the cathode current may be easily calculated by measuring the voltage across the cathode resistor and dividing its value while it is still hot.

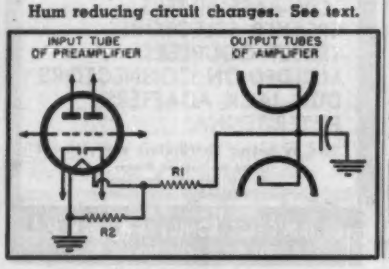
To cite an example, in the writer's amplifier the cathode current from the output tubes was 135 ma. The input tube in the preamplifier was a 12AX7, the heater of which is rated at 150 ma. (series) or 300 ma. (parallel). The heater circuit was therefore hooked up as shown in the diagram. Since the heater resistance of the 12AX7 is about 85 ohms when the tube is hot, the value of R_1 was that of the original cathode resistor minus 85 ohms. In general, the value of the cathode resistor will be greater than the resistance of the input tube heater so that several heaters may be placed in series if desired. If the cathode current is too large, it is a simple matter to shunt (R_2) the heaters to get rid of the excess. The current used should be about 10 per-cent less than the rated value for the tube heater.

The use of d.c. on the heaters of the low-level preamplifier stages will result in a hum decrease of 10 decibels or better. In everyday terms, this can make the difference between a hum discernible from the other side of the room and one detectable only within a foot of the speaker, at normal listening levels.

The use of a heater current slightly less than the rated value will help considerably to reduce noise (tube hiss) at the sacrifice of a negligible amount of gain. Any remaining noise may be further reduced by replacing the cathode and plate resistors of the low-level stages by low noise resistors of the deposited carbon type.

Despite the seeming simplicity of this suggestion, this method works extremely well. Audiophiles with a slight technical flare and the courage to open the backs of their equipment will find that the time and trouble involved are well worth it. While it may seem to be a case of overdoing things a bit, the critical listener whose record library includes a generous sampling of chamber music, solo instrument performances, leider, and other traditionally "quiet" music will find that the removal of excessive noise and hum from their equipment will double their enjoyment of their selections. In any event, the suggestion has been made. Rest assured that the author has tried this circuit out and can vouch for its effectiveness. —30—

Hum reducing circuit changes. See text.



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Electronics on Hurricane Ship

(*Continued from page 40*)

are transponder drift buoys, for instance, that answer a radio call from their mother ship or plane so that she can track them. There are also robot hydrographic observers that can be anchored in out-of-the-way spots, even submerged. A sonic call from the mother ship will bring them to the surface, and they then signal their whereabouts by radio.

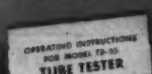
In many of these research aids the circuitry is new. Some ideas await the development or genius-stroke of a usable circuit. In such things as the drift buoys, where power supply is limited and weight and size are critical factors, the use of transistors will be important. Transistor circuitry will also be useful in sensing elements lowered from a ship. An example is a new salinity-temperature-depth instrument under development for use at the end of a cable. Many of the salinometer functions described earlier will be carried on far under water, by servomotor and other control from the ship. Much of the salinometer circuitry will have to be "packed in the can" along with much of the power supply. Here the transistor with its small power requirements will come into its own.

The study of hurricanes, big as these storms are in man's way of looking at things, is the study of mere "backfires" in the ocean-air heat engine in the tradewind belt. As every reader knows, a gigantic, coordinated international effort at examining the entire "machinery" of the earth is being made during the International Geophysical Year, 1957-58. The "Crawford" and the other Woods Hole ships are participating in this exciting venture.

At the end of January, 1957, the "Crawford" left Woods Hole once more for the tropical Atlantic on a four-month preliminary cruise (the IGY actually runs from July 1, 1957 to December 31, 1958). On this cruise we brought along special sampling equipment for studies of the age of the deep Atlantic waters by the *Carbon-14* method, along with the equipment described so far. The hurricane work is not being abandoned in the IGY. All the IGY findings on oceanic and atmospheric energy will probably have a bearing on it.

Oceanography is rather new to the public, although it has been recognized as a scientific province for more than a century. Until recent years there was rather little publicity on all that oceanographers have been doing. The field has been growing in scope, size, and importance, especially as land resources dwindle and the world's population increases. The oceans are an almost untapped source of food, minerals, and energy. Oceanography will soon be recognized as a "new frontier." Its instrumentation will be a new frontier in electronics. We have hardly more than punctured the surface of this vast and virtually unexplored field. —30—

Model TD-55 — Terms:



Model TV-40 — Terms: $3.85

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Signals bounced off moon picked up by an earth satellite tracking station.

SIGNALS transmitted by powerful radar equipment of the Army Signal Corps at Fort Monmouth, New Jersey, and reflected by the surface of the moon have been received by one of the earth satellite tracking stations, it was disclosed by the Army and Navy.

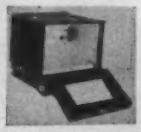
Using the giant radar transmitter "Diana," Signal Corps engineers have been bouncing signals off the moon for several years. At Blossom Point, Maryland, the Navy's Minitrack test facility has received these signals during several test pickups.

The purpose of the tests is to perfect a technique by which the operation of all of the Western Hemisphere satellite tracking stations can be tested as soon as they have been completed and placed in operation. This technique can also be used to calibrate satellite tracking stations set up by amateurs in various parts of the Western Hemisphere, Africa, Europe, and the islands of the Pacific.

The receiving equipment being used in the tests is the Mark II Minitrack being designed by the Naval Research Laboratory for use by volunteer radio tracking stations throughout the world. However, the equipment was modified because the Diana transmitter was operated at 151 megacycles for these tests instead of the regular 108 megacycle Minitrack frequency used in the satellite tracking system.

In all, there are planned some ten Minitrack radio tracking stations which, when placed in operation, will follow and report the movement of the earth satellite as it travels around the world. Stations will also pick up scientific data concerning the experiments being conducted with instruments carried within the satellite. —30—

"Diana" moon radar antenna used for tests.



BC-221 FREQUENCY
CASE OR TS-164 Meter Case, With Voltage Regulator Tube VR-105 & two Ballast, Relay, etc. Front Comp. 9¾" x 7½" x 7¾". Rear Compartment 2" Deep. NEW: $3.95

PULSE ANALYZER INDICATOR
ID-228/APA-64—Contains two 200 Microammeters, 2½" Meters: Pulse rate Freq.: 0-500 & 0-100 scale, and Multiplier Switch x1—x2 & x10. Other Meter Pulse Width w/0-5 & 0-20 scale Multiplier x1 & x4; plus On & Off and Reset Switch.
USED: $6.95—NEW: $9.95

PANADAPTOR OSCILLOSCOPE
1D-80/APA-17—Indicator with 5" Scope Tube, 5JP2, 6V6, 6SN7, 6SJ7, 2/6AC7, 2/6H6 Tubes. Scope Controls Focus, Horizontal, Vertical, Intensity, & Gain. Also 400 cycle Selsyn Motor.
Prices: NEW: $14.95—USED: $9.95

INTERPHONE KIT
Interphone Kit — Consisting of H-22 Handset with recoil Cord. Handset Holder in metal box. 35 Ft. 7 Cond. Cable, 14 Ft. Flex. Conduit, Switch Box, Tape, Instruction Book & Extra Parts—NEW: $9.95

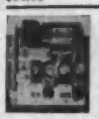
ROCKET TRANSMITTER
1330 to 1850 KC—with 18 Ft. circumference 'Parachute. Spark Gap Transmitter, used for jamming; battery operated and with mechanical timer control. Size: 40" H x 7" Dia. T-95/CRT-2.....NEW: $7.95

POWER SUPPLY PP-111/APS-10
Complete with Tubes: VR-105, 6X5, 5R4, 6V6, 6SN7, & 2X3. Input 115 V 400 cycle & 24 VDC; Output 4000 VDC, 105 VDC & 300 VDC. Sheet-mounted Chassis, Size: 9" W x 11" H x 12" D.
NEW: $8.95—USED: $5.95

INDICATOR ID-99/APS-10
With 5FP7 Scope Tube, 6AL5, & 2/6AK5 Tubes. Includes Video, Deflection, Focusing, & Brilliance Controls.....Used: $4.95
ID-11/APS-4 5" Scope Tube 5FP7 & 2/6J6 Tubes..New: $3.95

MAGNETS — MAGNETRON MAGNETS, as pictured—Approx. 1800 Gauss, shown at left: $12.95—Approx. 4800 Gauss, shown at right: $14.95

HIGH FREQ. RECEIVER
53 to 63 MC—For remotely controlled radio systems on preselected fixed Freq. Complete with 6 Tubes: 1/6SN7, 3/6SL7, 1/6SG7, 1/6J5 and 24 Volt Dynamotor.
Price.....New: $7.95



ANTENNA RADAR
AS-N/APS-3—With 18" Reflector, 24 VDC Motor, Position Indicator and Wave Guides.....NEW: $19.95

RECEIVERS—TRANSMITTERS:

SCR-522 Rec-Trans. 100 to 156 MC.....Used:	$34.95
RT-19/ARC-4 Rec-Trans. 144 to 148 MC. Less Tubes.....Used:	12.95
BC-375 Trans. 100 Watt; 200-500 KC; 1500-12000 KC.....Used:	29.95
TA-12 Trans. 100 Watt; 300-600; 3000-7000 KC.....Used:	32.95
T-23 Trans. 100 to 156 MC.....Used:	14.95
BC-625 Trans. 100-156 MC (Part of SCR-522).U:	22.50
BC-457 Trans. 4 to 5.3 MC.....Used:	4.95
BC-458 Trans. 5.3 to 7 MC.....Used:	4.95
BC-696 Trans./Navy Type—3 to 4 MC.....Used:	4.95
Navy Type Comm. Trans.—2.1 to 3 MC: New: $9.95; Used:	7.95
BC-230 Trans. w/Coils—2300-7700 KC....Used:	8.95
BC-624 Rec. 100-156 MC (Part of SCR-522).....Used—W/Tubes:	19.95
Used—No Tubes:	9.95
RA-10 Rec. 150-1100 KC & 2-10 MC w/ Control Box & Cable.....Used:	34.95
BC-1206 Rec. 200-400 KC.....Used: $4.95; New:	9.95
R-4/ARR-2 Rec. 234 to 258 MC.....Used:	6.95
R-24/ARC-5 Rec. 500 to 1500 KC.....New:	19.95
Navy Type Rec. 1.5 to 3 MC.....Used:	7.95
BC-454 Rec. 3 to 6 MC.....Used:	7.95
BC-455 Rec. 6 to 9 MC.....Used:	7.95
BC-229 Rec/w/Coils—2500 to 7700 KC....Used:	6.95
BC-946 IFF Rec. 100-211 MC—13 Tubes..Used:	5.95

NOTE: For items previously advertised but not listed here, please write for Catalog. Sent free on request!

FM COMMUNICATION EQUIP.

FM RECEIVER—10 Tubes, continuous Tuning & Push Button Tuning on 10 preset channels — complete with Tubes, Speaker, Squelch Circuit, & 2 Phone Jacks. Power required: 220 VDC 80 MA & 12 VDC.
BC-3050 REC.—30 to 50 MC, Converted, ready to operate. Used, Checked—Specify Freq. $34.95
BC-683 REC.—27 to 38.9 MC. Used, Checked...$39.95
BC-603 REC.—20 to 27.9 MC. Used, Checked...$19.95
BC-604 TRANS.—90 Watt, 20 to 27.9 MC Crystal Control. Ten Preset Channels. Power required: 625 VDC 225 MA & 12 VDC. Prices: Used..$14.95—New..$19.95
BC-924 TRANS.—90 Watt, 27 to 38.9 MC. Four Preset Channels. Power required: 400 VDC 400 MA. Not Crystal Control. Prices: Used...$14.95—New...$19.95
OUTPUT & INPUT PLUGS for Rec. & Transmitter $1.00
FT-237 BASE to hold Rec. & Trans. Used: $9.95—New: $14.95
DM-34 12 V Dynamotor For BC-3050, 603, 683—Used, Checked: $2.95
117 Volt 60 Cycle Power Supply f/BC-3050, 603, 683 .....$17.95
DM-35 12 V Dynamotor For BC-604.....Used: $12.95
DM-65 12 V Dynamotor For BC-924.....Used: $12.95

BC-659 TRANS. & REC.
BC-659 Trans. & Rec. FM—27 to 38.9 MC—Crystal Control on Two Preselected Channels. 5 to 10 Watt—Complete with Tubes, Speaker, etc.—Used $29.95
POWER SUPPLY for BC-659—6 or 12 VDC. Used: $9.95; 117 V 60 Cycle .....New: $34.95
I-208 FM SIGNAL GENERATOR—Standard of Voltage Frequency and Frequency Deviation for the test alignment, calibration, sensitivity measurements of FM Receivers. Frequency Range 1.9 to 4.5 MC & 19 to 45 MC. Frequency Deviation can be adjusted 0 to 5 KC for 1.9 to 4.5 MC and 0 to 50 KC each side for the 19 to 45 MC Band. Stability .03 percent through use of crystal calibrator. Modulation Freq.: 150-400, 1000, 2500, & 5000 CPS. With Output Meter & Speaker; 115 Volt 60 cycle or 12 VDC Input—Used.....$59.50

G. E. PYRANOL COND.
G. E. PYRANOL CONDENSER—25.6 MFD. 1000-2000 Volt Operating. Size: 3½" x 3¼" x 6⅛". Can negative. Prices: $4.95 ea. — Or 2 for $9.00

AMPLIFIER
Using 2/6V6 Tubes, Carbon Mic. Input and tapped output Transformer. Audio Oscillator for signaling. Complete with Tubes & Case (less Dynamotor) BC-667—New $2.95
BC-212 AMPLIFIER, Using 2/6C5 Tubes..New: $1.95

DYNAMOTORS & POWER SUPPLIES:
DYNAMOTORS—See our last month's Ad—or write us your needs!

117 V 60 cycle Power Supply For BC-1206	$18.95
117 V 60 cycle Power Supply For 274/ARC-5	18.95
117 V 60 cycle Power Supply F/BC-603-683-3050..	17.95
117 V 60 cycle Power Supply F/BC-348-312 etc. ..	18.95
GN-45 Hand Generator—6 V 3 A; 500 V 140 MA w/Leg & Seats	9.95
PE-110 Power Supply—117 V 60 cycle—BC-669. New:	49.50

MISCELLANEOUS:

ID-60/APA-10—3" Scope, 21 Tubes—New	$49.50
SCR-625 Mine Detector—Reconditioned	39.95
AM/PDR-T2 Geiger Counter—Used, Checked	14.95
Crims Detector—Ultraviolet & Mercury Vapor, Light Assy.—New	69.50
Visual Identification Flash Assy.—6 or 12 Volt, New:	29.50
EE-8 Field Telephone Set—Reconditioned	14.95
RM-52 Remote Control Unit—Used: $ 1.95—New:	2.95
RM-53 Remote Control Unit—Used: $ 2.95—New:	4.95
RM-12 Remote Control Unit—Used: $14.95—New:	19.95
RM-18 Remote Control Unit—Used: $18.95—New:	22.95
RM-29 Remote Control Unit—Used: $ 3.95—New:	4.95

Frequency Standard OSCILLATOR TS-385
Shown at left of picture—Crystal controlled, 375 to 418 MC; 115 V 60 cycle input; Tubes: 6X5, 6X7, 6J5, 6V6, 6A8, & 3020. KC Crystal w/Schematic. Prices: Used ..$9.95—New ..$12.95
SIGNAL GENERATOR I-196—Shown in right corner of picture—8 to 15 MC, with Modulation. Complete with 3 Tubes, 115 V 60 cycle. Size: 10½" L x 7" D x 8" H. With Cover. Used .....$6.95—New $9.95

TRANSMITTER
Crystal Control—3.5 to 4 MC, 50 Watts; MO—PA for CW. With Automatic Keyer Motor & Code Wheels. 2/1625 & 1/25LG Tubes. Complete with Instruction Book & Conversion, T-121—New $7.95

RANGE BEAM FILTER
1020 cycle acceptance or rejection. W/PL-55 Plug & Cord for plugging into Rec. Two output jacks. New.....$1.95
FL-8 Filter, Used.....$1.50
FL-5 Filter $1.00

Address Dept. RN • $5.00 Order Minimum • 25% Deposit on C.O.D.'s • All Prices F.O.B., Lima, Ohio

FAIR RADIO SALES 132 SOUTH MAIN ST. LIMA, OHIO

Model 770-A — Terms: $3.85 after 10 day trial then

Model TD-55 — Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.
OPERATING INSTRUCTIONS FOR MODEL TD-55 TUBE TESTER
Model TV-12 — Terms: $22.50 after 10 day trial then $10.00 per month for 5 months.
Model TV-40 — Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.
Model TW-11 — Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER

NO C.O.D.

Superior's New Model TD-55

EMISSION TYPE TUBE TESTER

FOR
- **The Experimenter or Part-time Serviceman,** who has delayed purchasing a higher priced Tube Tester.
- **The Professional Serviceman,** who needs an extra Tube Tester for outside calls.
- **The busy TV Service Organization,** which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket. It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system. The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin or even the "top-cap."

Checks for shorts and leakages between all elements. The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification. One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Complete with carrying case..... **$26.95** NET

Superior's New Model TV-40

PICTURE TUBE TESTER

Not a Gadget—Not a Make-Shift Adapter, but a Wired Picture Tube Tester With a Meter for Measuring Degree of Emission—at Only $15.85

Of course you can buy an adapter for about $5—which theoretically will convert your standard tube tester into a picture-tube tester; or a neon type instrument which sells for a little more and is supposed to be "as good as" a metered instrument. Superior does not make nor do they recommend use of C.R.T. adapters or neon gadgets because a Cathode Ray Tube is a very complex device, and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else.

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well-established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (ion trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Only..... **$15.85** NET

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

TESTING TUBES

- **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.
- **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.
- **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.
- **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

Extra Feature

Model TV-12 Also Tests Transistors!

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Housed in hand-rubbed oak cabinet..... **$72.50** NET

Superior's New Model TW-11

STANDARD PROFESSIONAL TUBE TESTER

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. **Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test.** Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. **Thus it is impossible to damage a tube by inserting it in the wrong socket.**
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE: SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Housed in hand-rubbed oak cabinet..... **$47.50** NET

USE APPROVAL FORM ON NEXT PAGE ➡

Model TV-50 — Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

Model 76—Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.

Model 770-A — Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

Model 670-A — Terms: $7.40 after 10 day trial then $3.50 per month for 6 months.

TRY FOR 10 DAYS

before **you buy!** ***then*** **if satisfactory pay in easy, interest free, monthly payments. See coupon below.**

Superior's New Model TV-50

GENOMETER

7 Signal Generators in One!

- ✓ R.F. Signal Generator for A.M.
- ✓ R.F. Signal Generator for F.M.
- ✓ Audio Frequency Generator
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.
VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.
BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.
CROSS HATCH GENERATOR: Pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.
DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.
MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

$47.50 NET

Complete with shielded leads

Superior's New Model 670-A

SUPER-METER

A Combination VOLT-OHM MILLIAMMETER *PLUS* Capacity, Reactance, Inductance and Decibel Measurements.

ADDED FEATURE: Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

SPECIFICATIONS:
D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

$28.40 NET

Complete with test leads

Superior's New Model **76**

- ✓ IT'S A CONDENSER BRIDGE
- ✓ IT'S A RESISTANCE BRIDGE
- ✓ IT'S A SIGNAL TRACER
- ✓ IT'S A TV ANTENNA TESTER

SPECIFICATIONS

✓ **CAPACITY BRIDGE SECTION** 4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

✓ **RESISTANCE BRIDGE SECTION** 2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

✓ **SIGNAL TRACER SECTION** With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

✓ **TV ANTENNA TESTER SECTION** Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals.

$26.95 NET

Complete with R.F. and A.F. probes and test leads

Superior's New Model 770-A **POCKET-SIZED**

VOLT-OHM MILLIAMMETER

● **USING THE NEW "FULL-VIEW" METER 71% MORE SCALE AREA**—Occupies exactly the same space used by the older standard 2½" Meters, yet provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain *measurements instead of approximations.*

● Compact—measures 3⅛" x 5⅞" x 2¼". ● Uses "Full View" 2% accurate, 850 Microampere D'Arsonval type meter. ● Housed in round-cornered, molded case. ● Beautiful black etched panel.

Specifications: **6 A.C. VOLTAGE RANGES:** 0-15/30/150/300/1500/3000 Volts. **6 D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/1500 Volts. **2 RESISTANCE RANGES:** 0-10,000 Ohms, 0-1 Megohm. **3 D.C. CURRENT RANGES:** 0-15/150 Ma., 0-1.5 Amps. **3 DECIBEL RANGES:** —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

$15.85 NET

Complete with test leads

We invite you to try before you buy any of the models described on this and the preceding page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-392, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name .....

Address .....

City ..... Zone..... State.....

All Prices net. F.O.B. N.Y.C.

- ☐ Model TW-11.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 76.....Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TD-55.....Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TV-50.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TV-40.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model 670-A.....Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.
- ☐ Model 770-A.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model TV-12.....Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.

broadcast signals for which the set was designed thus eliminating the need for an r.f. gain control to prevent overload

1957

QUARTZ CRYSTALS

Fast Service—
Unconditional Guarantee!

Crystals ground and etched to your specified frequency at the lowest cost in the industry— supplied in popular FT-243 holders, ½" pin spacing, .093" pin diameter—also in DC-34 holders, ¾" pin spacing, pin diameter .156 or FT-171 holders, pin spacing ¾" with banana plug pins (fits 5-prong tube socket).

In FT-243 holders from 1001KC to 2500KC:
.01% tolerance....$1.75
.005% tolerance...$2.50
2501KC to 9000KC:
.01% tolerance....$1.50
.005% tolerance...$2.50
Also available in MC-7 or FT-171 holders at above prices. (Specify holder wanted.)

HERMETICALLY SEALED OVERTONE CRYSTALS

Supplied in HC6/U metal holders, pin spacing .486", pin dia. .050"—pin diameter .093" also available. Specify diameter wanted, otherwise .050 supplied.

10 to 30 MC .005 tolerance.... $3.85 ea.
30 to 54 MC .005 tolerance.....$4.10 ea.
55 to 75 MC .005 tolerance.....$4.25 ea.
75 to 90 MC .005 tolerance.....$5.50 ea.
(Write for quantity prices)

NOVICE CRYSTALS

80 meter band within 1KC of specified frequency from 3701KC to 3749KC in 40 meter band from 7152KC to 7198KC within 1KC of specified frequencies in FT-243 holders..... 99¢
ANY AMATEUR BAND CRYSTAL from 3500KC to 8650KC, .05% tolerance..... 99¢
(Add 5¢ per crystal for postage & handling.)

SPECIAL! RADIO CONTROL CRYSTALS

27.255 MC sealed crystals.....$2.50 ea.

MARINE FREQUENCY CRYSTALS

.005 Tolerance—available in FT-243 holders, or MC7 (pin spacing ¾", dia. .125") holders.

2009	2182	2670	2977	$2.50 ea.
2110	2406	2738	3021	
2126	2637	2953	3093	
2174	2638	2961	3193	

(Other marine frequencies available at $2.50 ea.)

Stock crystals in FT-243 holders from 5675KC to 8650KC in 25KC steps 50¢.

FT-241 lattice crystals in all frequencies from 370KC to 540KC 50¢.

200KC Crystals	2.00
455KC Crystals	1.00
500KC Crystals	1.00
1000KC Frequency Standard Crystals	3.50
Dual socket for FT-243 crystals	.15

Low frequency FT-241 crystals from 880.20KC to 1040.62KC in steps of 1040 cycles 75¢

(Write for complete listing.)

MANY ELECTRONIC PARTS DISTRIBUTORS NOW HAVE TEXAS CRYSTALS IN STOCK

Texas Crystals
The Biggest Buy in the U.S.
8538 W. GRAND AVENUE · RIVER GROVE, ILL.
ALL PHONES—GLADSTONE 3-3555

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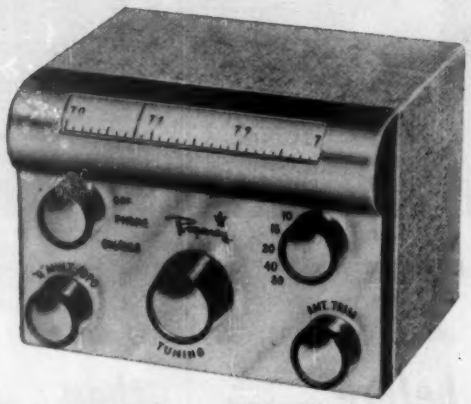
Transistorized Ham Converter



Regency Model ATC-1 ham converter that uses two transistors and is powered by three 1.5-volt penlite battery cells.

Compact and self-contained, this new unit for the ham or SWL uses a surface-barrier transistor as the converter.

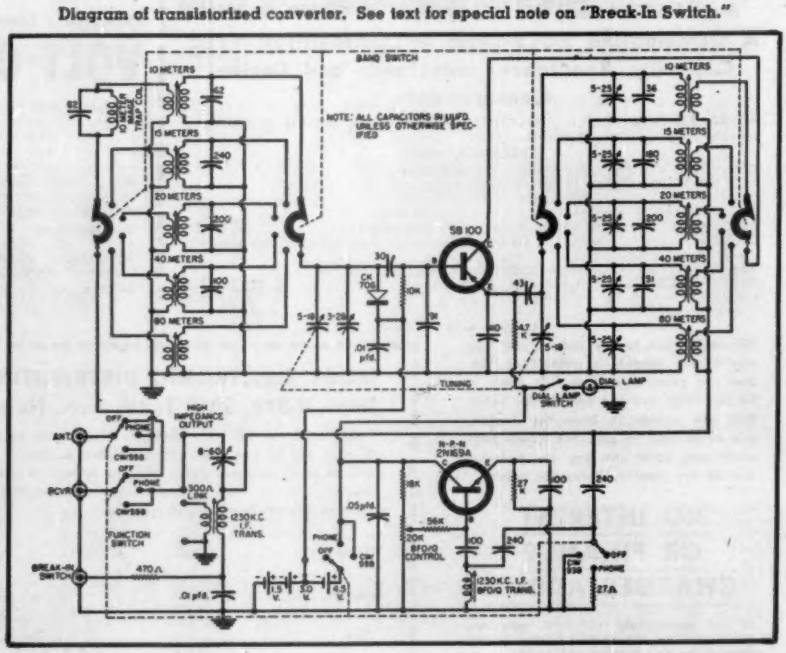
THE VERSATILITY of the surface-barrier transistor is responsible for yet another development—this time an extremely compact, lightweight amateur band converter, the *Regency* Model ATC-1.

Designed to be used with any broadcast receiver (auto, portable, or home type), the converter makes possible the reception of amateur signals on the 80, 40, 20, 15, or 10 meter bands. The unit is self-powered by three 1.5-volt penlite cells, thus eliminating the necessity for making any alterations in the receiver to obtain power for the converter.

The surface-barrier transistor (a *Philco* SB-100) functions as the converter (oscillator-modulator) while a type 2N169A *n-p-n* transistor is used as a *"Q"* multiplier for phone reception and as a beat oscillator for c.w. The local oscillator circuit operates on the fundamental for reception of the 80, 40, and 20 meter bands and on the second harmonic for the 15 and 10 meter bands. Harmonic operation on these bands helps reduce oscillator pulling when the antenna circuit is tuned.

With the ATC-1 it is unnecessary to remove the car radio to add sockets, switches, or gain controls. The i.f. signals (1230 kc.) which are supplied to the car, portable, or home radio are of the same general magnitude as the

Diagram of transistorized converter. See text for special note on "Break-In Switch."



broadcast signals for which the set was designed thus eliminating the need for an r.f. gain control to prevent overload.

The circuit was designed to provide phone, c.w., and SSB reception as well as allow break-in operation when the ATC-1 is used with a transmitter. In this latter mode, a phono pin jack, indicated as "Break-In Switch" on the accompanying schematic, becomes an important circuit feature. This jack permits the collector circuit of the SB-100 mixer to be opened by a set of contacts on the transmitter relay, thus disabling the converter during transmission. A shielded, single conductor cable should be used for wiring to the relay. *It is important that no voltage be applied to this circuit.* A shorting phono pin jack is supplied with the converter and should be inserted in the "Break-In Switch" jack when break-in operation is not desired.

The "Off" position of the function switch serves the dual purpose of turning the converter power off and connecting the antenna directly to the automobile receiver for the reception of standard broadcasts. After the car radio has been used for this purpose, when returning to converter operation the broadcast receiver should be tuned in the region of 1230 kc. until the b.f.o. carrier is heard. Next the "BFO/Q Control" should be rotated in a counterclockwise direction until the carrier ceases. Now advance the control slowly in the clockwise direction until the carrier just re-appears. The receiver can now be set accurately to the carrier. This procedure is especially important when receiving c.w. or SSB signals. If the car radio is of the push-button type, one of the push-button positions can be set up for converter use.

One interesting feature of this converter is a novel switching device that has been incorporated in the design to eliminate the current drain of the dial lamp, which incidentally is many times that of the converter circuit. When the user wishes to illuminate the dial, he pushes *in* on the tuning knob. Upon releasing the knob, the dial light is extinguished.

This new converter is small enough so that it can be mounted almost anywhere in the car, including under the dash, in the glove compartment, or on the steering post. The unit is equipped with mounting rails to allow complete flexibility of installation. Four felt feet are furnished with the converter to act as cushions when the converter is used with a portable or home set. These may be removed when mounting the converter to a bracket—thus providing additional mounting holes over and above those provided specifically for that purpose.

While there is no doubt that more and more ham gear will be transistorized as the cut-off frequencies of these versatile components are lifted, this new *Regency* unit represents an interesting departure from standard converter practice—a trend which should be noted by hams and SWL's. —30—

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8 MFD— 500 V	75c Ea.	1 MFD—2000 V	1.50 Ea.
1 MFD— 600 V	35c Ea.	3 MFD—2000 V	1.95 Ea.
2 MFD— 600 V	50c Ea.	8 MFD—2000 V	2.50 Ea.
3 MFD— 600 V	75c Ea.	1 MFD—2500 V	1.25 Ea.
4 MFD— 600 V	75c Ea.	4 MFD—2500 V	2.50 Ea.
6 MFD— 600 V	75c Ea.	2 MFD—4000 V	4.50 Ea.
6 MFD— 600 V	75c Ea.	2 MFD—5000 V	4.95 Ea.
8 MFD— 600 V	$1.00 Ea.	.5 MFD— 500 V	.75 Ea.
		.25 MFD—1000 V	.39 Ea.
Dual 8x8 MFD—600 V	1.25 Ea.	.05 MFD—2500 V	.50 Ea.
		.5 MFD—3000 V	.50 Ea.
10 MFD— 600 V	1.75 Ea.	.25 MFD—3000 V	.50 Ea.
1 MFD—1000 V	.75 Ea.	.2 MFD—5000 V	.75 Ea.
2 MFD—1000 V	.75 Ea.	.25 MFD—6000 V	1.00 Ea.
8 MFD—1000 V	1.50 Ea.	.1 MFD—7500 V	1.95 Ea.
10 MFD—1000 V	1.50 Ea.	.1 MFD—12000 V	2.50 Ea.

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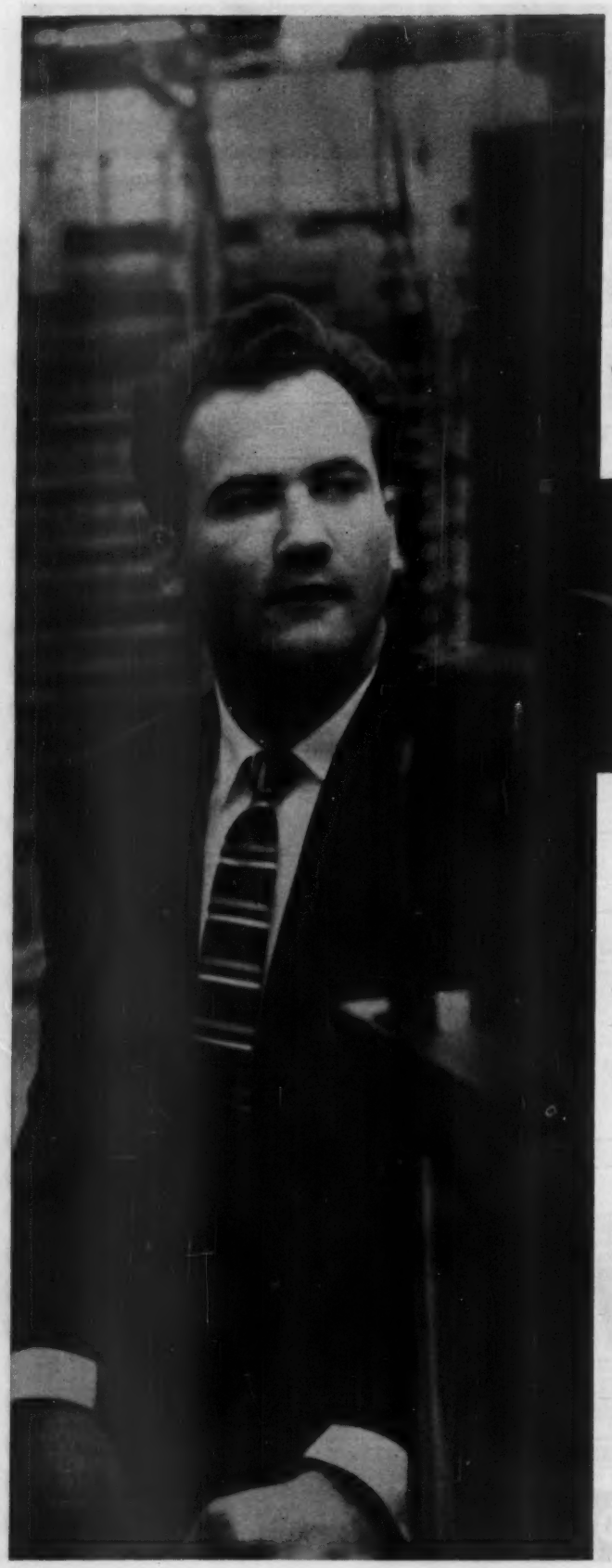
What is Project SAGE?

at McGuire Air Force Base, but his

If you have 2 years' technical



How Far Can You Go in Electronics Without a Degree?

"Student" Fred Gunther in the IBM school

Fred Gunther has no degree. Yet, today, at IBM, Fred is a Technical Engineer working on America's biggest electronics project. His story is significant to every technician who feels that lack of formal training is blocking his road to the top.

Let's go back to 1950 and watch Fred Gunther, at 18, as he goes about the business of determining his life's work. Fred spent almost a year trying his hand at various jobs. None of these turned out to be the one that Fred wanted to devote his life to. So, still undecided about his career, Fred entered the Navy for a four-year hitch.

Fred learned something very valuable in the Service, as have many other men who eventually discover the electronics field. His aptitude tests revealed him as an excellent electronics prospect, and he received ten months' training in electronics fundamentals and radar. Upon his discharge in 1955, he was an Electronics Technician, First Class.

Something even more important to Fred's career occurred during his Service hitch. He began to hear such terms as "automation" . . . "data processing" . . . "electronic computer." "Then, one evening, while glancing through the paper," he recalls, "I spotted a story about *Project SAGE*."

What is Project SAGE?

SAGE means Semi-Automatic Ground Environment. It is part of America's radar warning system—a chain of defense that will ultimately ring our country's entire perimeter. At the heart of this system are giant electronic computers, which digest data filtered in from Texas towers, picket ships, reconnaissance planes, ground observers. The computers analyze this information for action by the Strategic Air Command and other defense units. These computers are the largest in the world. Each contains perhaps a million parts—occupies an entire city block. They are built for the Project by IBM.

Answering instructor's questions

Fred joins IBM

SAGE fascinated Fred, for it embodies the most advanced electronic concepts in giant computer work. And, when he learned that IBM would train him at full salary, plus a living allowance, to become a Computer *Units* Field Engineer, he seized the opportunity. Fred started his new electronics career in the IBM school, with twenty other technicians. He attended classes 8 hours a day. Courses consisted of some 20 subjects—computer circuitry and units, maintenance techniques—everything he would need to become a full-fledged Computer *Units* Field Engineer.

Assigned to McGuire AFB

His training completed, Fred was assigned in May, 1956, to McGuire Field, where the first of the giant SAGE computers is located. Here he assisted in the cable installation for this vastly complicated electronic giant. He helped to set up the computer, interconnect its many sections, check it out and make it ready for operation. Fred spent five months at McGuire Air Force Base, but his education was not yet completed.

Becoming a Computer *Systems* Engineer

"I like to think it was due to my interest and grade of work," Fred says, "but at any rate, last October I was invited to return to Kingston for further training—to become, in fact, a Computer *Systems* Engineer. Naturally, I was proud and pleased, for this training would give me a much greater range of understanding . . . make me more valuable to the company and myself . . . and give me a chance to assume actual engineering responsibility." Fred completed the

At the operating console of the computer

Computer Systems course. After several months of outstanding work in his new capacity, he received a *third* promotion—to Technical Engineer—in a field engineering liaison group.

What does the future hold?

What does the future hold for Fred Gunther, now that he has become a Technical Engineer? "It's hard to even set a goal in a field as rapidly moving as this," Fred says, "but with my IBM training back of me, the future sure looks good. I've advanced from Radar Technician to Computer *Units* Field Engineer to Computer *Systems* Engineer to Technical Engineer *in two years*—and received a valuable electronics education besides!"

How about YOU?

Since Fred Gunther joined IBM Military Products and the Project SAGE program, opportunities are more promising than ever. This long-range program is destined for increasing national importance, and IBM will invest thousands of dollars in the right men to insure its success.

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Why Service Associations?

(Continued from page 66)

nents manufacturers to police the service industry. This is the sole responsibility of the service dealers who are really sincere in their desire to build a stable, respected industry out of their activity.

Component and tube manufacturers have spent and are spending thousands of dollars in national advertising in an effort to upgrade the independent service industry in the eyes of the public. Paraphrasing the biblical statement that "the rain falls alike on the just and the unjust," these manufacturer-financed programs can only be a blanket endorsement of all independent service shops, including the gyps and the incompetents.

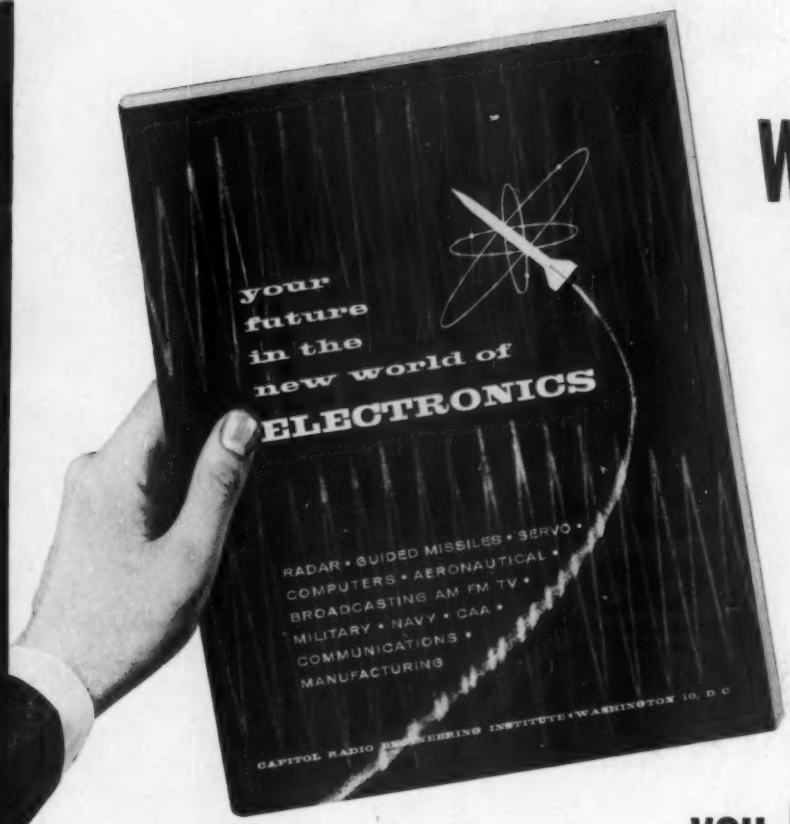
During the past two months your author had the unique opportunity of getting a good cross-section of consumer thinking about independent service shops by talking to more than fifty set owners who misinterpreted a telephone directory listing and called his office for TV service. All of these people were primarily interested in two things. First, they wanted to know the charge for a home service call. Second, they were deeply interested in the type of guarantee given that the work would be performed satisfactorily.

The consumer resistance to paying five dollars per service call is solely the fault of independent service dealers. Every person who called expressed resentment against paying five dollars for service that, on previous occasions, had required only about ten minutes of a technician's time to replace one or two defective tubes. The service calls plus the tubes had cost these people an average of nine dollars per job, which they felt was high for the small amount of time and labor involved.

People do not resent paying for service if they feel they are getting full value. One service dealer working alone could not cope with the tremendous public-relations program that is needed. It will require education of service dealers themselves as well as the general public. But service dealers working together in a local association can pool their resources in programs that will improve set owners' acceptance of adequate charges for competent service time.

The second assurance the public wants is that the work will be performed satisfactorily. Here, again, service associations can enhance the prestige of their members by putting an association guarantee back of the service jobs performed by its members.

This is the age of collective action. Cooperation and active participation in a local association of service dealers is the only insurance policy an independent service dealer can buy against being steam-rollered out of business by factory or captive service. —30—



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TUBE TYPE	KNOBS A Cir.	B Fil.	C Load	LEVER POSITION Up	Down
5CZ5	1	5	25	4	57
5DH8	1	5	23	5	34
5DH8 (Test 2)	2	5	20	5	348
6BL8	3	6.3	20	4	58
6BL8 (Test 2)	2	6.3	20	4	57
6BR5 (Eye OP)	4	6.3	0	4	257
6BR5 (Eye CL)	4	6.3	0	4	25
	No open element test.				
6BS8	2	6.3	22	4	58
6BS8 (Test 2)	2	6.3	21	4	35
6CQ8	1	6.3	22	4	58
6CQ8 (Test 2)	1	6.3	22	4	57
6CX8	1	6.3	24	4	15
6CX8 (Test 2)	2	6.3	23	4	56
6CZ5	1	6.3	25	4	57
9A8/PCF80	3	7.5	20	4	58
9A8/PCF80 (Test 2)	2	7.5	20	4	57
12CX6	1	12.6	26	3	147
25EC6	3	25	17	2	37
30A5	3	32	16	3	14
EL36	3	6.3	16	2	78
UCH81	1	12.6	20	5	34
EY82	3	6.3	17	5	34
5842/417A	1	6.3	23	3	69
	No open element test.				
6516	1	6.3	24	3	24
6611	1	1.2	25	3	5
6612	1	1.2	23	3	5

TRIPLETT MODEL 3413-B

4BC5	1	4.2	08	156	237
5CZ5	1	4.7	21	1369	57
5DH8	1	5	19	12	34
5DH8 (Test 2)	2	5	20	679	58
6BL8	2	6.3	23	19	58
6BL8 (Test 2)	2	6.3	22	236	57
6BR5 (Eye OP)	4	6.3	0	127	4
6BR5 (Eye CL)	4	6.3	0	12	4
	No open element test on pins 1, 2, 7.				
6BS8	2	6.3	22	12	34
6BS8 (Test 2)	2	6.3	22	67	48
6CQ8	1	6.3	19	19	58
6CQ8 (Test 2)	1	6.3	19	236	57
6CX8	1	6.3	20	23	14
6CX8 (Test 2)	2	6.3	23	789	56
6CZ5	1	6.3	21	1369	57
9A8/PCF80	3	9.45	18	19	58
9A8/PCF80 (Test 2)	2	9.45	20	236	57
12CX8	1	12.6	23	256	137
25EC6	3	25	15	580	23
30A5	3	32	16	2567	13
EL36	3	6.3	20	50	7
UCH81	1	19.6	20	89	34
UCH81 (Test 2)	1	19.6	19	1267	34
EY82	3	6.3	16	9	34
5842/417A	1	6.3	19	14578	69
	No open element test on pins 4, 5, 7, 8.				
6516	1	6.3	19	157	23
6611	1	1.4	22	124	5
6612	1	1.4	20	124	5

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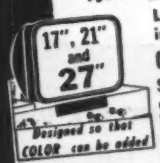

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1950 record of 1400 miles almost doubled by amateurs.

TWO radio hams made radio history on July 8th when they carried on a two-way contact on the 144 mc. band over a distance of 2600 miles—exceeding the previous record by some 1200 miles.

John Chambers, W6NLZ of Palos Verdes Estates, California was in radio-telegraph contact with Ralph Thomas, KH6UK at Kahuku, Oahu for more than an hour.

Thomas, the engineer in charge of the *RCA Communications* station at Kahuku, has been working toward this goal almost since the day he was assigned to his Hawaiian Islands post more than two years ago. He and Chambers have been testing daily for more than nine months prior to the break-through on July 8th. Chambers is an engineer employed by *Douglas Aircraft* at Santa Monica. His home at Palos Verdes Estates is 910 feet above sea level, with a clear view out over the Pacific.

Both amateurs used the maximum power allowed (1 kw. input to the final amplifier stages of their home-built transmitters). Highly sensitive, low-noise receivers, also home-built, contributed to making reception possible. The Hawaiian station used a huge antenna array consisting of four 24-foot yagi-type bays arranged in box formation. A 13-element, 24-foot yagi was used at the West Coast station.

The exact nature of the propagation medium has not been definitely established, but the stable quality of the signals received at both ends of the circuit indicate that exceptionally stable weather conditions over the Pacific may have been responsible. If this is true, it is the first time that tropospheric propagation has been observed over anything approaching this distance.

Making amateur radio history is not a new thing with Ralph Thomas. As W2UK at Rocky Point, L. I., he was among the leaders in the International DX Competitions of the ARRL for several years in a row back in the 1930's. In 1953, from New Brunswick, N. J. he embarked on a cooperative program of investigation of the possibilities of 144 mc. communication by means of reflection of signals from meteor trails, a form of communication now being exploited for military and commercial purposes. His work in this field won for him and his co-worker, Paul M. Wilson, W4HHK, of Collierville, Tenn., the ARRL Merit Award for 1955, in recognition of their outstanding contribution to the art.

-30-

Practical Color TV

(*Continued from page* 69)

modulator, instead of detecting chrominance information indiscriminately, is sensitive only to that information which has been modulated onto the subcarrier in the phase prescribed for it.

Thus the demodulation of the chrominance signal results in two color-difference signals which, in this case, are the *R-Y* and *G-Y* signals. Since the output of demodulators like the ones shown in Fig. 8 are quite high in level, they may be applied directly to appropriate grids in the picture tube without further amplification.

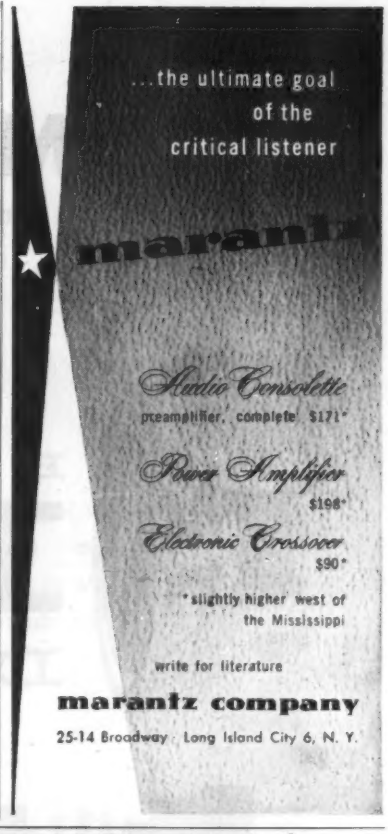
This still leaves us with the necessity of deriving a *B-Y* signal for application to the blue grid of the three-gun tube; but such a signal may be established, once the *R-Y* and *G-Y* signals are known, through a matrix circuit. This is a network, which may or may not be associated with a stage of amplification, in which two signals are combined in the proper proportions to develop a third.

For a typical matrix amplifier, we turn to Fig. 7, used by *Motorola*. In the particular receivers where this stage is used, it happens that the two demodulated color-difference signals are the *R-Y* and the *B-Y*. It is therefore necessary to obtain a *G-Y* signal, in this case, to round out the three required for the three guns of the picture tube. The *R-Y* signal is applied to the grid of the matrix amplifier through the 150,000-ohm resistor, while the *B-Y* signal is applied to the same point through a 270,000-ohm resistor. This establishes the desired ratio for mixing these two signals to derive the third, and it is in this correct ratio that the combined signals appear across the 6800-ohm grid resistor.

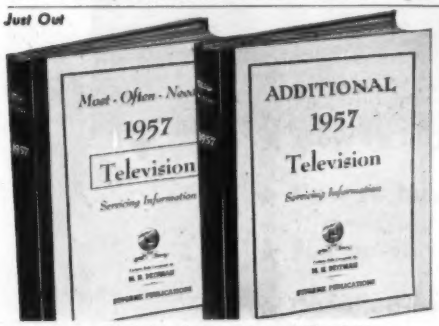
Although there is no intention of going into the mathematical details of color-signal development in this treatment, it should be pointed out that a mixture of *R-Y* and *B-Y* signals in the manner shown will result in a *G-Y* signal that is opposite in phase for proper use with the other two. It is designated as the — (*G-Y*) signal. However, due to phase reversal in passing from grid to plate of the amplifier, the proper *G-Y* signal is available after amplification for direct application to the picture tube.

The basic circuits outlined here are the foundation of modern color receivers. Differences occur, and they are important from the standpoint of servicing. It is up to service technicians themselves, in the long run, to become familiar with specific receivers as they come into contact with them, through circuit diagrams, service data, and other sources. For this type of learning, no substitute has been found. However, a fundamental understanding of circuits is the necessary preparation.

(*To be continued*)



Just Out



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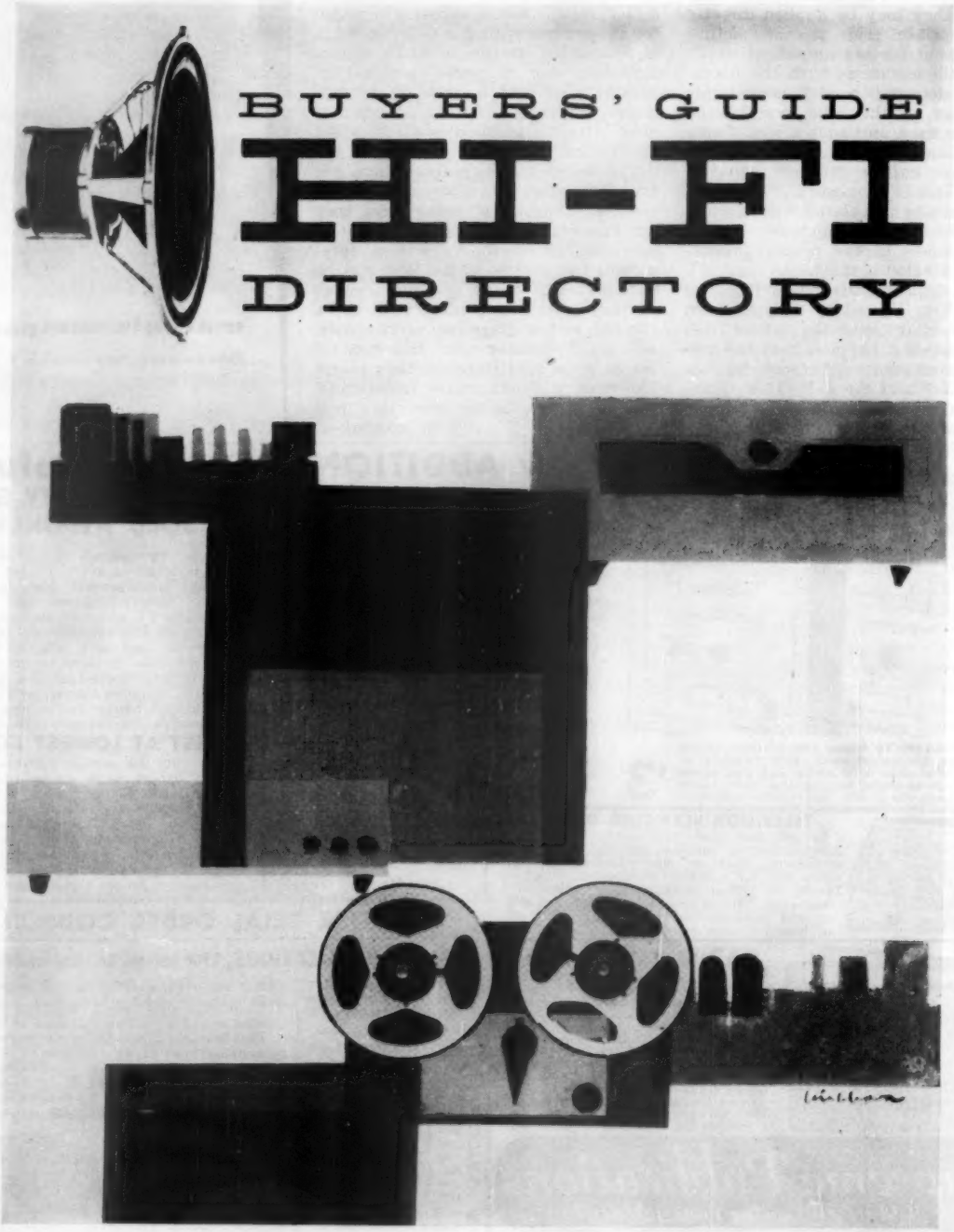

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Tracking External Hum

(Continued from page 43)

line voltage was present in the antenna system. With the offending set turned on, almost the full line voltage was dropped across the transformer primary, with no appreciable hum voltage left to be fed on to the antenna system. Thus, when his receiver was not in use during the day, the interfering hum modulation was available at substantial levels. When he used his set in the evenings or during weekends, the symptom disappeared! Since removal of the ground wire from the neighbor's set produced no complications, this connection was left off permanently.

There are many other ways in which leaks from power lines can result in interfering hum. Overhead power lines are not unusual offenders in this regard. The power companies will be more than willing to correct such a situation when it is found to be the cause of externally introduced hum, as the power leaking away costs them money. Just tell them about it.

Where such power losses occur past the point where the lines enter the individual meters, it is the consumers who pay, of course. Aside from the cost and the annoying interference, there is an additional reason for remedying this situation: it represents a fire hazard.

The indoor antenna hooked up to a receiver and used as a tracing probe is extremely useful in tracking all of these external hum sources. The symptom becomes more severe as the location of the point of origin is approached. If symptoms like these develop on a small-sized radio, incidentally, there is no need to add a probe antenna. If the radio can be carried about, its integral antenna can be used in probing for the source.

Sometimes the chase, as in detective work, does not produce results. The technician still has an alternative, however. He can install a power-line filter at the set. It should reduce the signal picked up over the lines. By this attenuation, the hum modulation will be reduced as well. Very often, an extra filter at some other outlet will produce better results than just a single one at the radio or TV set.

Quite a number of radio-caused hum modulation cases arise from defective light bulbs or fixtures with leaks. These can be found by snapping suspected equipment off and on while watching or listening for a symptom. Here the power line serves as an antenna for the r.f. signal and has plenty of a.c. power available too.

If the "off-on" technique yields no results, the rabbit ears will help. A ferrite-core antenna from a portable radio is also excellent for "tracking" operations in the broadcast band. This type of antenna is highly directional, which makes it especially valuable in such probing operations. —30—

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Color Organ

(*Continued from page* 45)

near the baseboard, shining upwards along the wall. By doing this the light reflected not only varies in intensity, but will appear to change in size, a small area resulting from weak sounds, and a tall column or fan of light occuring during loud passages. This additional element of spaciousness is appreciably more dramatic, as well as being easier on the eyes, than looking directly at the light sources.

Certain musical compositions and recordings appear to reproduce much more effectively over the color organ than others. This is due to a complex of factors and for most effective synchronization a program should not only have adequate energy distribution in all parts of the audio spectrum, but should be orchestrated in such a manner that the various frequency ranges are well separated from time to time. In many instances instruments which may be heard clearly will simply not have sufficient energy to actuate the particular channel of the color organ satisfactorily but, on the other hand, sometimes surprising things are discovered about a particular piece of music because the color organ will call attention to the fact that appreciable sound intensity exists in a region that the mind had previously ignored.

The color organ appears to provide a good indication of musical balance, both in regard to the instrumental pickup in the initial recording session, and in the matter of over-all frequency response. This is due to the fact that the three channels, if matched to each other, are the equivalent of three separate volume indicators, providing an indication of the amount of audio energy instantaneously present in each frequency band. As a consequence, the setting of the audio amplifier bass and treble controls will affect the performance of the color organ as well as the content of a particular recording. In addition, the dynamic characteristics of the color organ may be altered to an appreciable degree by adjustment of the thyratron bias controls. Adjusting the bias to the point where the filament of the bulb just glows will provide the maximum sensitivity and most linear operation, while overbiasing the tube will decrease the sensitivity of the particular channel and cause the thyratron to be actuated only on musical peaks.

A wide number of variations are possible in the design and operation of color organs, but the utility of the thyratron need not be limited to lighting control, and may easily be applied to many other situations requiring the use of modest amounts of power. One final precaution, however, is to keep the thyratron circuits well isolated from high gain amplifier input stages, as the ionization of the gas in the thyratron tube may cause a disturbing noise in the audio system. —30—

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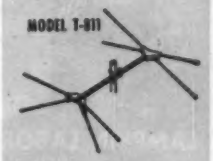

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such probing operations. —30—

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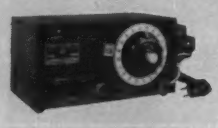

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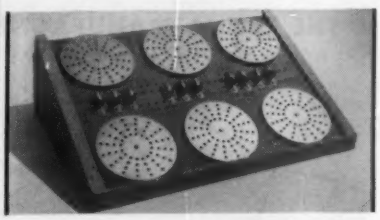

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Low-Power 2-Way Radio

(*Continued from page 75*)

To facilitate service and maintenance, most manufacturers of mobile radio equipment make available special test sets or test meters designed especially to speed the checking of their particular units. These sets incorporate an indicating meter and a function-selector switch which provides a choice of a number of key check points in the mobile unit. A multi-lead cable connected to the test meter plugs into a jack on the communications unit. In this way, with a single connection and test set-up, important maintenance and repair checks throughout the equipment are possible. On the "Impster," designed for use with the *Kaar* "IMP," the instrument also serves as a field-strength meter. Final adjustment of the transmitter section includes adjustment of the final r.f. stage, with the antenna plugged in, for maximum reading on the field-strength meter.

A monitor receiver is a valuable shop device for checking transmitter performance and for determining that the channel is clear.

The shop should be provided with a 6- and 12-volt d.c. power source to permit check-out of equipment on both d.c. and a.c. The voltage source should be adjustable so that actual operating conditions can be simulated. For example, the voltage reaching the radio unit may vary from 5.5 volts to 7.5 volts or from 11 volts to 15 volts, depending upon the electrical system of individual vehicles and whether a 6- or 12-volt battery is used. Transmitter power output and receiver sensitivity should be checked at both high and low extremes of input voltage.

Recommended test equipment for use in a shop where mobile 2-way units are handled is listed in Table 1.

Transmitters may only be serviced by persons holding a first- or second-class radio operator's license, or by unlicensed personnel only when working under the supervision of a technician holding a valid ticket.

Servicing low-power industrial radio equipment requires care because of the limited power output and restriction on antenna height, hence, there is not much power available to waste. By keeping receiver sensitivity high and power output as close as possible to maximum authorized limits, optimum performance can be realized. —30—

Table 1. Recommended test equipment.

Precision-grade v.h.f. signal generator
Conventional signal generator (for I.I. alignment)
R. f. wattmeter or dummy antenna
Frequency meter
Adjustable 6- and 12-volt d.c. power supply (with ammeter)
General-purpose tube tester
Grid emission tester
Oscilloscope
Vacuum-tube voltmeter
Special test meter or adapters for all types of equipment to be serviced
Multimeter (20,000 ohms-per-volt)
Monitor receiver

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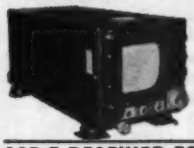

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ASB-5 RECEIVER FOR 420 Mc BAND!

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Tuning Knob for ASB-5 Receiver.....**$1.29**

MN26Y BENDIX DIRECTION FINDER

150-325 Kc; 325-695 Kc; 3.4-7 Mc. Complete with tubes, motor. **$26.95**
BRAND NEW.....
Used, like new, incl. tubes and dynamotor. .**$18.95**

BENDIX DIRECTION FINDER

12-tube remote control Navigation Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands, 28 V. DC input. Ideal for commercial navigation on boats and planes. Complete installation comprises:

MN-26-C Receiver, used, with 12 tubes	$16.50
MN-26-C With 12 Tubes, BRAND NEW	$24.95
MN-20-E Rotatable Loop	4.25
MN-52 Azimuth Control Box	2.95

All necessary accessories for above in stock.

ARB NAVY RCVR-XMTR

The Receiver Four band, 195 to 9050 Kc. Low Freq. Ship, Broadcast, 40 to 80 meters. Includes tubes and dynamotor for 24 V operation. Easily converted for 110 V, 12 V or 6 V. Schematic included. BRAND NEW. Overall 8¼"x7¼"x15¼". Wt. 30 Lbs. Complete with all tubes.

The Transmitter, tunes 3000 to 9050 Kc and 2300 to 4200 Kc. Massive, fully encased unit, complete with all tubes. Three completely integrated tuning units included. All Brand New.

The Xmitter Dynamotor has input of 27.5 V DC @ 7.4 A; output: 425 V DC @ .320 A, with Filter Base. Brand New.
Complete Assembly,
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BC1206-C BEACON RECEIVER

195 to 420 Kc, made by Setchel-Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. BRAND NEW.. **$8.88**
Brand New, less tubes..**$5.95**
USED, with tubes....**$5.95**
USED, less tubes..... 2.95

DYNAMIC HANDMIKE, with "Press-to-talk" Switch, cord and plug—BRAND NEW, only.....**$2.95**

DYNAMIC HEADPHONES, 600-ohm impedance, with large earphone cushions, cord and phone plug. BRAND NEW, special.....**$3.95**

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TS-9	Handset		4.95

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Model	Description	Excellent Used	BRAND NEW
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1—2V. 20 Amp. Hr. Willard Storage Battery **$2.79**
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2-meter Superhet, 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes. **$20.45**
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SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters. BRAND NEW, less tubes..... **$7.95**
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Easily converted for use on radio-TV Service Bench!

BRAND NEW
Completely Assembled
Supplied with 5" Scope type 5CP1..... **$15.95**

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ALL COMPLETE WITH TUBES

Type	Description	Excellent Used	Brand NEW
BC-453	Receiver 190-550 KC.	$10.95	$12.95 $14.95
BC-454	Receiver 3-6 Mc.	7.19	8.29 11.95
BC-455	Receiver 6-9 Mc.	5.25	7.95 9.95
BC-456	Modulator	2.95	3.45 4.95
BC-450	3-Receiver Control Box		1.49 1.95
BC-451	Transmitter Control Box		1.25 1.49
BC-696	Xmtr 3-4-Mc (like new)		6.95 8.88

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.. **$7.88**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal.
BRAND NEW **$7.88**
BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal.
BRAND NEW **$11.95**
ARC-5/T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal **$8.88**

110 VOLT AC POWER SUPPLY KIT

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Terrific buy! VHF Transmitter-receiver, complete with all components. 100-156 Mc, 4 channels. Xtal-controlled, Amplitude modulated voice. They're going fast! Excellent condition.
SCR-522 Transmitter-Receiver, complete with all 18 tubes.
COMBINATION.....Special **$33.33**

Receiver Only, with all tubes..$19.50
Transmitter Only, with all tubes..$22.25

234-258 MC RECEIVER

AN/ARR-2, BRAND NEW, tubes included: 7-9001, 3—6AK5, 1—12A6. Schematic included. Complete with 11 tubes, our low price:
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With 28 V. 1.6A Dynamotor, complete $12.95
110 VOLT AC POWER SUPPLY KIT for above.....**$9.75**

FREE!

Schematic Diagram included FREE with each piece of equipment shown on this page. Schematics for any of these units also available separately at 50c each.

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BRAND NEW

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. This swell rig originally cost over $1000—yours for practically a song! You get it all, in original factory carton, BRAND NEW, complete with 17 tubes, less power supply. **Conversion Instructions Included.** **$29.50**
Shpg. wt. 25 lbs.....

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) .....only **$7.95**
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FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual. **$129.50**
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Special Buy! Complete with operating manual, LIKE NEW.....only **$119.50**

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Type	Each	Per Dozen	Per Hundred
RK65	$7.25	....	....
2J724B	.35	$3.95	$29.50
VR105	.79	8.88	70.00
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815	2.99	....	....
826	.44	4.95	39.50
829B	7.95	....	....
832A	5.95	....	....
837	1.15	....	....
1625	.26	2.75	21.50
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6002R	3.95	....	....

NEW! Cathode Ray Tubes NEW!

3CP1	$1.18	5BP4	$2.22
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Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.95
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DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A	....	7.95
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All parts, components, etc. of the "Edu-Kit" are 100% unconditionally guaranteed, brand new, carefully selected, tested and matched. Everything is yours to keep. The complete price of this practical home radio and electronics course is only $22.95. There is nothing extra to buy.

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6 oz. Aerosol Can. Net to servicemen.

Non-toxic, non-inflammable, insures trouble-free performance.

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Extra economical because a small amount does the job!

Volume Control and Contact Resterer with Perma-Film

Cleans, lubricates, protects . . . NOT A CARBON-TET SOLUTION. Still available in the new 6 oz. spray can.

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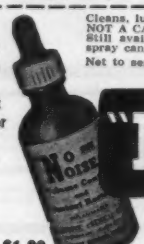

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Hot Chassis Hazards

(*Continued from page* 41)

117 volts up out of the chassis where it can be the cause of a nasty shock, or worse, to some unwary user of the set.

Even the routine operation of soldering during repair may be the eventual cause of a jolt to some customer from a "hot" chassis, unless care is exercised. That stray blob of solder that lands in an inconvenient spot on a transformer-powered chassis may do no more harm than cause an annoying crackle as it shorts out somewhere in the circuit. On a set using a potentially "hot" chassis, it may land in the very fine space between this chassis and a subchassis that has presumably been isolated. If it does, we can rely on no warning crackle: it will lurk there quietly and dangerously, keeping line voltage applied to the "safe" subassembly, ready to do its damage when some innocent comes along and puts his hand on a part of the set where he has every reason to believe he may proceed in safety.

Because of these possibilities, which are hard to spot visually, every repair job on a transformerless receiver should be followed by a voltmeter check. With the receiver cord inserted in an outlet first one way, then the other, a check should be made between external ground and every portion of the receiver that is subject to contact by people. Where a metal cabinet is involved, the same test should be repeated between cabinet and external ground after the set has been reassembled.

In the customer's home, a meter should again be employed, this time between the receiver's proper chassis ground and some such external ground as a radiator, a water pipe, or the metal plate of the wall outlet. The set owner should be duly impressed with the unpleasant possibilities, as dramatized by the meter reading, and the cord should finally be left inserted so that the chassis is at external ground potential. If the set owner can be persuaded to permit the installation of a polarized plug (and outlet, if not already available), this should be done. Not as good as this precaution, but also effective, is the precaution of painting a red mark on the plug to line up with a corresponding red mark painted on the wall outlet. This acts as a guide for re-insertion of the plug in "safe" polarity if it is withdrawn for any reason.

Where a metal cabinet is involved, external grounding of this cabinet should be urged on the owner. This can mean a blown fuse if the plug is inserted the wrong way or if a live chassis should short to the cabinet—but this is simply a case of the fuse doing its job of providing protection from harm and warning that something is amiss. The cost of a fuse is a small price for peace of mind. —30—

Antenna News

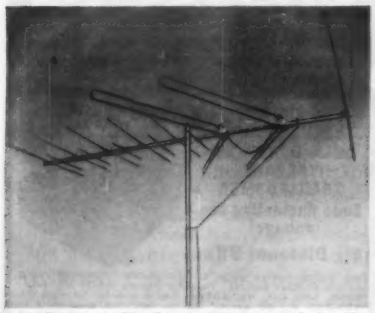
TV ANTENNA MASTING

Mechanical Steel Tubing Corp., 500 Barry St., New York, N. Y., has developed a new type of high-performance antenna mast, "Alum-A-Mast." It is made of polished continuously welded steel tubing. Resistance against corrosion is achieved by pre-coating the mast inside and out and then applying a baked aluminum finish. Swage and dimple locking devices eliminate the need for nuts and bolts in coupling sections and provide protection against turning. It is made in 5- and 10-foot sections and in 16-, 18-, and 20-gauge diameters.

HI-GAIN V.H.F. ANTENNAS

Channel Master Corp., Ellenville, N. Y., announces the 9-element "Color King" and the 13-element "Super Color King." A booster kit will convert the former into the latter if extra gain is desired after installation.

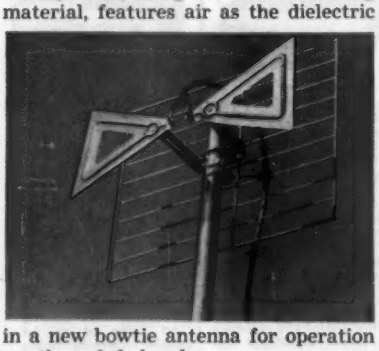
Both antennas use the controlled-



impedance dipole system originally developed for the Travelling-Wave antennas, plus impedance-compensating coils that do not resonate at high-band frequencies. The antennas snap into place without tools.

U.H.F. BOWTIE ANTENNA

Technical Appliance Corp., Sherburne, N. Y., using no other insulating material, features air as the dielectric



in a new bowtie antenna for operation on the u.h.f. bands.

Designed for use in prime signal areas, the antenna uses a sturdy bracket assembly to suspend the di-

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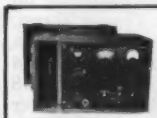
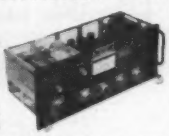


TS-16/APN Test Set—Used for alignment and calibration of ARN-1, APN-1 and other radio altimeters. Has 28-volt vibrator supply, audio generator, many valuable parts. Complete with all cables and sturdy wood case.
Now only **$7.95**

BC-906D Frequency Meter—144-225 mc. Battery operated. Complete with case. Only $6.95
RBH-2 Receiver—Tunes 300 kc to 17 mc. Built-in power supply for 115v. 50-60 c. Made by National. Good condition. Only $50.00
R9B/APN4 Radio Receiver. Used, good condition. Only $7.50
I-196B Signal Generator—Now only $3.95
TS-3/AP Wave-Meter, Watt-Meter—Cavity tuned 3400 to 3400 mc. New condition. A real buy $29.95
TS-3A/AP Wave-Meter, Watt-Meter—Only $69.95
RD-7/APA 23 Recorder—Used for frequency monitoring, time signal, etc. Requires 80-115 vac, 60 cycles and 28 vdc. New, with book $25.00
TS/170-ARN-5 Test Oscillator—330 mc. range. For Glide Slope receivers or other UHF applications. New, $14.95. Used, good condition $9.95
H-22A/U Handset—with hangar and two extra mic covers $5.25



RT-7/APN-1 Altimeter Transceiver—This terrific value includes all 14 tubes. 27-volt dynamotor and famous wobbulator unit. Like new ... $4.95
APR-4 Laboratory Receiver—40 to 3300 mc. Less tuning units $65.00

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Robert Umthun, 1918 Eye St., NW, Washington	1st	21
Tommy Lesley, 422 Wood St., Maysville, Ky.	1st	9
Dan Breece, Station KOVE, Lander, Wyo.	1st	12
Robert Todd, Station WWBG, Bowling Green, Ohio	1st	13
Jackson York, 1029 N. Quincy St., Arlington, Va.	1st	15
Paul Chuckray, 6674 Weber Rd., Affton, Mo.	1st	11

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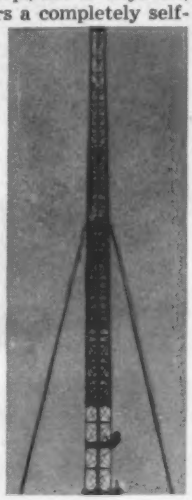
poles, making the air-dielectric principle possible.

Also featured in this unit, Model 3011, is an extra-large reflector for optimum directivity and gain. The screen is fully welded and coated with a protective finish.

ROTATABLE TOWER

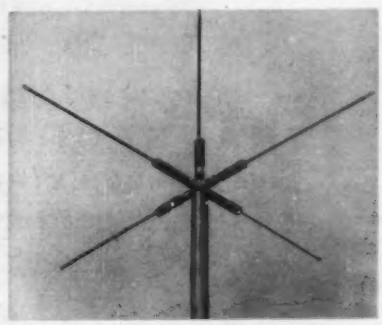
Tri-Ex Tower Corp., 127 E. Inyo St., Tulare, Calif., offers a completely self-supporting tower for ham or industrial use that can be rotated completely during use, eliminating the need for rotating motors for the antenna at the top of the tower. A motor accessory kit also permits raising and lowering the tower. Rotating on large ball-bearings at the 20-ft. level and also at the base, the tower may be rotated by hand without difficulty.



Tripod support rods extending to within 5 ft. of the base make guying unnecessary. The tower is engineered to support large arrays. Full engineering details are available from the manufacturer.

LIGHT COMMUNICATIONS UNIT

Tele-Beam Industries, Atlas Peak Rd., Napa, Calif., has an answer for those who wish a light, compact ground-plane antenna for use at a



base station in two-way systems. Model GPR, available for operation on any 4-mc. band between 27 and 90 mc., uses 5 base-loaded whips, including a vertical radiating element and 4 ground-plane members. Height is 18 in. and over-all width is a little over 3 ft. Weight is less than 3 lbs. This permits a lighter antenna support than is used for conventional antennas, while providing a unit in the 27-50 mc. band in the space normally required for units in the 152-174 mc. band. The manufacturer reports that, under test, these units are almost as efficient as conventionally designed quarter-wave antennas. —30—

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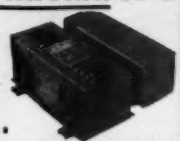
Ends fluctuating line voltage!



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the factory price at a 1-input 3,000 VA unit! And here's another bonus! This Air Forces 2,000 VA overstock, Sola Cat. No. 30768, has 4 inputs! 90-125 V., 190-250 V., 60 cy. or 50 cy. Isolated secondary is constant 115.0 V. ±1% from no-load to full-load of 17.4 amp. So, if you choose, use it as a 220:115 V. step-down. And slash $97.50 off the factory 1-input price!

Brand new in original wood box. 4 cu. ft. Ship. wt. 254 lbs. F.O.B. Pasco, Wash. Only . . . .

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"ACOUSTICS FOR THE ARCHITECT" by Harold Burris-Meyer & Lewis Goodfriend. Published by *Reinhold Publishing Corporation,* New York. 122 pages. Price $10.00.

The time when the architect could ignore acoustics in planning his structures has long since passed. Today, everyone is aware of the important role played by sound, or the lack of it, in establishing a satisfactory environment.

Until the appearance of this book, however, the men responsible for planning such environments were hard put to find the information they required. This volume seems to provide the answers to the most pressing considerations. The text is divided into eight chapters and covers an over-all presentation of the problem, what sound is and how it behaves, structure, materials, shapes and surfaces, electronic devices, surveys-computations-tests, and acoustical design procedures for specific structures such as, studios, concert halls, theaters, homes, apartments, libraries, public structures of various types, gyms and field houses, etc. Charts, tables, and checklists simplify the necessary acoustical design calculations, eliminating the need for the architect to consult outside references and sources.

Architects and acoustical engineering consultants will want to add this volume to their basic reference libraries.

* * *

"TV CONSULTANT" by H. G. Cisin. Published by *Harry G. Cisin,* Amagansett, N. Y. 69 pages. Price $2.00. Paper bound. 1957 edition.

This enlarged edition classifies over three hundred TV troubles, their diagnosis, and cures. The correct use of v.t.v.m.'s, sweep generators, and scopes in locating the defects is also covered.

The material is basic and the technique described by the author is designed to be used with any make or model of TV receiver.

* * *

"MARINE RADIOTELEPHONE PERMIT Q & A MANUAL" by Milton Kaufman. Published by *John F. Rider, Publisher, Inc.,* New York. 48 pages. Price $1.35. Paper bound.

By virtue of an amendment in the FCC rules, there are now some 50,000 persons in this country who will have to obtain a radiotelephone third-class license. These are the people who will have to man the radiotelephone gear which now must be installed on all vessels carrying, for hire, more than six passengers.

Designed to be used in conjunction

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A WELLER Soldering Gun gives you precise control of heat. This feature is especially important when replacing heat-sensitive components. Here are some typical applications:

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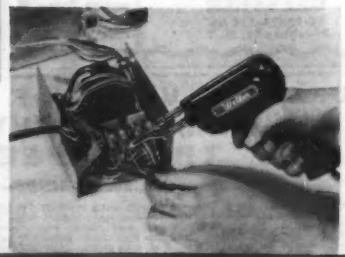
3 REPLACING CRYSTAL OSCILLATOR. Controlled heat is imperative for replacing crystal oscillator in color demodulator circuits. With a Weller Soldering Gun you get perfect heat control, thus avoid damage to delicate crystal element.



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8438	2	16	3100	10	4 1/2	2 1/4	3 1/2	3 1/4	13.48
8433	2½	17	2800	17	4 1/2	2 1/4	3 3/8	4 3/8	13.60
82	2¾	35	1550	28	5 51/64	2 13/16	4 13/32	4 3/8	16.50
81	2¾	40	3100	58	5 51/64	2 13/16	4 13/32	4 3/8	16.50
8473	3	35	1550	40	6 5/64	2 13/16	5 1/2	6 3/8	16.95
8472	3	40	3100	77	6 5/64	2 13/16	5 1/2	6 3/8	16.05
8442	2 Dual	18	3000	10-10	6 1/8	2 1/4	3 1/2	3 3/4	19.52
8434	2½ Dual	20	2800	17-17	6 1/8	2 1/4	3 3/8	4 3/8	20.59

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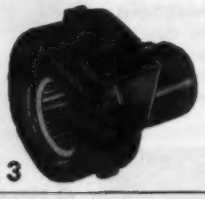

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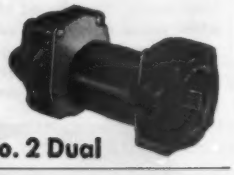

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with the special FCC study guide covering this license classification, this manual answers all of the questions likely to be asked of applicants and, in addition, supplements the answers with discussions of the background and principles involved. Two appendices list FCC field engineering offices where tests are given and an up-to-date summary of operating characteristics of FCC type-approved radiotelephone transceivers on the market.

* * *

"AUTOMATIC RECORD CHANGER AND TAPE RECORDER SERVICE MANUAL" compiled by Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 256 pages. Price $3.95. Paper bound. Vol. 9.

This ninth volume in this series provides complete service information on fourteen tape recorders and four record changers produced in 1956. Units made by *Ampex, Ampro, Bell & Howell, Chrysler, Columbia, Crestwood, Garrard, Miraphon, Mitchell, Pentron, RCA, Silvertone, Viking, Webcor,* and *Wilcox-Gay* are included.

For each model there is a "Photofact" exploded view, operational data, and detailed service instructions. An index listing all models covered in the first eight volumes of the series as well as those included in the present manual speeds location of service data on the desired unit.

* * *

"ELECTRICITY AND ELECTRONICS —BASIC" by William B. Steinberg & Walter B. Ford. Published by *American Technical Society,* Chicago. 235 pages. Price $4.50.

This would be a good book for the hobbyist, home craftsman, or student to cut his teeth on since the material covered is basic and the treatment is informal, practical, and non-theoretical.

The text is divided into six main sections, each made up of "units." The sections cover the electrical and electronic age, making use of magnetism, how electricity is produced, basic electrical circuits, electricity for everyday living, and using electricity for communication. In addition, a separate index headed "Interesting Things to Do" catalogues various projects the student can try in each category.

As an elementary handbook and a simple exposition for the student, this volume should do nicely. It is well illustrated and the projects outlined are varied enough so that there should be "something for everyone."

* * *

"AN INTRODUCTION TO THE CATHODE RAY OSCILLOSCOPE" by Harley Carter. Published by *Philips Technical Library,* Eindhoven, Holland. 95 pages. Price $1.95. At booksellers or from publisher direct.

This is another in the *Philips* "Popular Series" of technical treatises and covers the theory and operation of "general purpose" type oscilloscopes.

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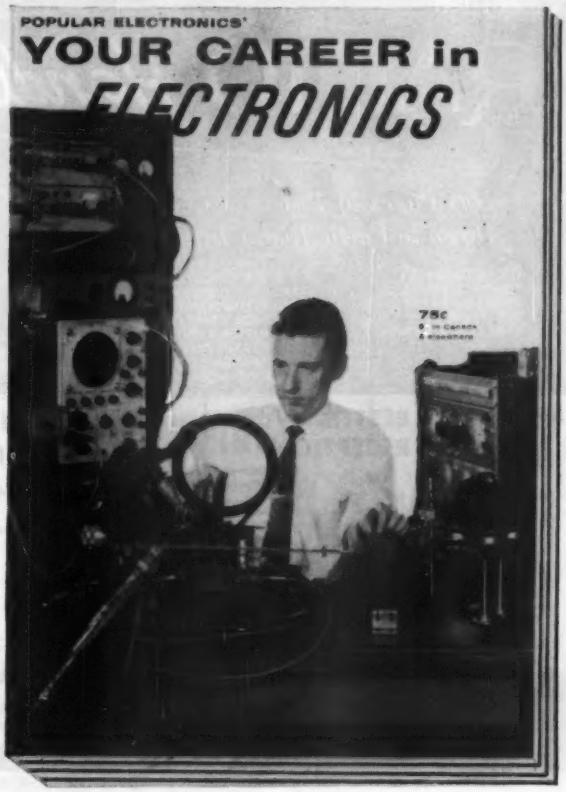

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eschewed mathematics in favor of simple and not-too-technical discussions of the tube itself, the time base, amplifiers and pickups, CRO power supplies, standard CRT's, and practical applications of the instrument. There are complete schematics for four commercial units, using *Philips* tubes.

The text is lavishly illustrated with graphs, schematics, and photos. For both beginner and the more experienced user of scopes, this book should be extremely helpful.

* * *

"TV TUBE LOCATOR" by H. G. Cisin. Published by *Harry G. Cisin*, Amagansett, N. Y. 32 pages. Price $1.50. Paper bound. Vol. 2.

This new volume covers some 5000 TV models which were released during 1955, 1956, and 1957. The index carries the maker's name, model number or tradename, and a reference to the page and diagram where the tube location data is given for the set.

The balance of the book is devoted to top chassis views of the receivers showing the locations of the tubes, CRT's, fuses, and controls.

* * *

"ADDITIONAL 1957 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications*, Highland Park, Ill. 192 pages. Price $3.00. Paper bound. Vol. TV-13.

This book is supplementary to the material published in the "Early-1957" volume and covers servicing data on TV receivers which have made their appearance subsequently. As customary with this publisher, large, double-page circuits are provided for each set along with alignment data, waveforms, voltage charts, service hints, parts lists, and factory suggested changes.

Fifteen manufacturers are represented in this new volume.

* * *

"TV TROUBLE TRACER—TV PORTABLES" by H. G. Cisin. Published by *Harry G. Cisin*, Amagansett, N. Y. 45 pages. Price 50 cents. Paper bound. Vol. 6.

This booklet covers many of the new portable TV receivers by various makers as well as tube location guides of the most recent *RCA* models, both portable and full size. The tubes shown on the chassis layouts are keyed as to function which helps to trace the trouble. Models using selenium rectifiers are so noted and whether or not series-connected heaters are employed is indicated. CRT patterns of the trouble run at the beginning of each section to indicate the symptom.

* * *

"TV ANTENNAS" by Martin Schwartz. Published by *American Electronics Co.*, 1203 Bryant Ave., New York 59, N. Y. 28 pages. Price 50 cents. Paper bound.

This is about as basic a text on the installation and repair of television antennas that you will find anywhere. The author painstakingly describes the different types of antennas, tells what

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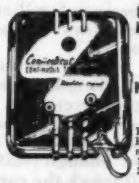

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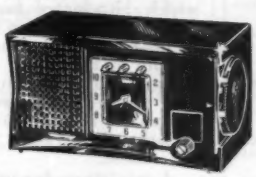

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they do, where they are used, and how they are installed and oriented. The three chapters which comprise the book cover antenna systems in general, installation procedures, and repair and maintenance.

* * *

"RECEIVING TUBE SUBSTITUTION GUIDE BOOK" by H. A. Middleton. Published by *John F. Rider Publisher, Inc.*, New York. 68 pages. Price $1.35. Paper bound. Third Supplement.

With the current widespread distribution of European-built electronic gear more and more technicians find themselves confronted with the problem of finding U. S. substitutes for foreign tubes. One of the main sections of this guide is devoted to European-American and American-European equivalents. Two other sections cover receiving tube substitutions and picture tube equivalents. In each instance the original tube is listed, its substitute listed, an estimate of its performance is given, and then the necessary circuit changes outlined, where required.

This supplement carries a cumulative index which covers all of the tubes in this and the two preceding supplements as well as the original volume, "Receiving Tube Substitution Guidebook." —30—

A TWO-TRANSISTOR RADIO RECEIVER

THE demand for compact transistor receivers seems to be almost insatiable as more and more of the "build-it-yourself" crowd become familiar enough with transistor circuitry to tackle receiver construction.

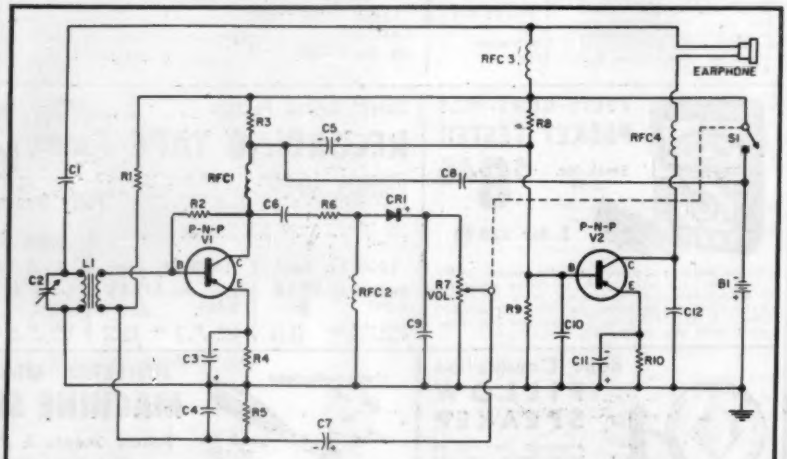
The circuit shown below is an extremely efficient reflex type which provides good reception of local broadcast stations without the need for an external antenna—the ferrite coil antenna being sensitive enough for short-range reception. Although the commercial version of this receiver, the Allied "Knight" kit 83-Y-262, comes with a printed circuit panel which eliminates much of the wiring chore, the circuit can be assembled using standard wiring techniques.

One of the newly developed alkaline batteries (RCA) is provided with the kit and it plus the extremely low current drain of the transistors used permit months of operation without battery replacement.

A miniature dynamic earphone, 4000 ohms or better, on a three-foot cord permits "personalized listening" so this set can be used virtually anywhere. The receiver, as supplied in kit form, weighs a mere 11 ounces. Allied provides a simulated leather carrying case for the receiver which is designed to clip on a belt or be hand carried. The kit is priced at $14.65. —30—

Over-all view of "Knight" transistor set.

Schematic of two-transistor receiver. Standard parts are used in construction.



R_1, R_8—47,000 ohm, ½ w. res.
R_3—82,000 ohm, ½ w. res.
R_5—2200 ohm, ½ w. res.
R_4—1000 ohm, ½ w. res.
R_6—10,000 ohm, ½ w. res.
R_9—82 ohm, ½ w. res.
R_7—10,000 ohm volume control (with switch S_1)
R_{10}—3600 ohm, ½ w. res.
R_{12}—180 ohm, ½ w. res.
C_1—82 μμfd. disc ceramic capacitor
C_2—400 μμfd. variable capacitor
C_3, C_{11}—90 μfd., 3 v. elec. capacitor
C_4, C_9, C_{10}, C_{12}—.005 μfd. disc ceramic capacitor
C_5, C_7—5 μfd., 6 v. elec. capacitor
C_6—.001 μfd. disc ceramic capacitor
C_8—.01 μfd. disc ceramic capacitor
L_1—Ferrite loop antenna
RFC_3—.5 mhy. r.f. choke
RFC_1, RFC_2, RFC_4—1 mhy. r.f. choke
CR_1—1N34A germanium diode
B_1—6 volt battery (RCA VS-300)
S_1—S.p.s.t. switch (on R_7)
Earphone—4000- ohm earphone (or higher)
V_1, V_2—"p-n-p" junction transistor (RCA 2N140 or equiv.)

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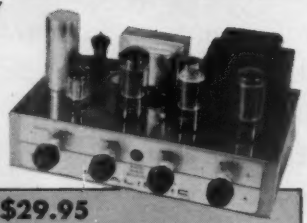

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NEDA SUPERVISION PLAN

The National Electronic Distributors Association (NEDA), 343 S. Dearborn St., Chicago 4, Ill., has issued a simplified plan for the supervision of outside salesmen's daily selling activities.

Entitled "Sales Supervision of Distributors' Salesmen," the book is said to be the first of its kind produced specifically for the electronic parts distributor. The six simple forms recommended will provide the facts and figures required to adequately supervise and control such daily activities.

The forms, available from NEDA are: salesman's daily report, record of customer's purchases (4 years), salesman's date book (record of calls and orders), registered prospect follow-up system, weekly report of "pushline" sales, and monthly quota and sales record.

Distributors interested in using this new plan can install it progressively if desired. Contact NEDA for information.

THERMOSETTING TAPES

Minnesota Mining and Manufacturing Co., 900 Bush St., St. Paul 6, Minn., has issued a new four-page booklet which outlines the properties, recommended application procedures, and advantages of *"Scotch"* brand electrical tapes with thermosetting adhesive.

A property table lists physical and electrical properties for 15 tapes with paper, cloth, film, and laminated backings ranging from class A through class H temperature classifications.

Copies of "Thermosetting Electrical Tapes" are available without charge by writing Dept. D7-207 of the company.

ELECTRON TUBE DESIGN

An Air Force guidebook for the design of electron tubes with longer life and increased reliability has been released for industry use through the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

The volume covers the factors influencing electron tube life through a study of tube design, materials, and processing. From the information provided, circuit and systems design engineers as well as tube users can estimate the effects of variables on the reliabilities of their systems and devise means of lengthening tube life, increasing reliability, and reducing servicing costs.

Written by T. H. Briggs of the Wright Air Development Center, "Electron Tube Operation as Influenced by Temperatures and Voltage" contains 90 pages and is priced at $2.50 a copy. Orders should be sent to the OTS. Payment must accompany such requests.

INSTRUMENTATION TAPES

Minnesota Mining and Manufacturing Company, 900 Fauquier Ave., St. Paul 6, Minn., has released an 8-page brochure covering its line of "Scotch" brand magnetic tape for instrumentation use.

Each tape is described as to its special features and properties and then this information is presented in tabular form for ready comparison and selection.

RCA DISTRIBUTOR BROCHURE

The Components Division of *Radio Corporation of America*, Camden, N. J., has issued a new 22-page brochure covering its complete line of electronic components and test equipment sold through distributors.

wiring and socket base diagrams, electrical characteristics, and other impor-

The company's authorized tube and transistor distributors will supply this

Copies of this new publication are available without charge upon direct

Entitled *"RCA* Electronics Components," the new publication includes more than 115 photographs and illustrations covering its new line of service test equipment and accessories, "Gold Label" speakers, hi-fi speakers and enclosures, styli and cartridges, TV receiver parts, service parts for radios and phonographs, and the company's complete line of batteries.

The brochure is available from independent distributors or from the division direct.

NEW IRC PUBLICATIONS

International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa. has issued four new publications covering its resistor, potentiometer, and component lines.

The "Electronic Components Guide" contains comprehensive data on a complete line of resistors and electronic components (including those of the firm's subsidiary, *Circuit Instruments Inc.* and the *Hycor Division*). Data given includes JAN or MIL equivalents, rated wattage, standard tolerance, temperature rise, temperature coefficient, maximum operating temperature, ohmic values, and dimensions.

Bulletin G-1b provides full details on the firm's Type MV high voltage resistors; Bulletin A-3a deals with the construction, dimensions, materials, etc. for Type 2W rheostat potentiometers; while Bulletin P-4 provides full details on Type PW-20 resistors.

Write the manufacturer direct for any or all of these publications.

TOBE SERVICE CAPACITORS

Tobe Deutschmann Corporation, 3455 Vega Ave., Cleveland, O. has just issued a 26-page, two-color catalogue covering its line of service capacitors.

The publication (#5701) provides complete specifications, list and net prices, and other pertinent data on a line of molded tubulars, metalized paper, ceramic disc, twist-prong electrolytic, tubular electrolytic, and industrial type capacitors.

The company's local distributors have copies of this catalogue or it can be ordered from the manufacturer.

TRANSISTOR SERVO AMPS

Daystrom-Transicoil Corp., a *Daystrom* subsidiary, Worcester, Montgomery County, Pa. is now offering copies of its single-page data sheet which lists complete specifications on a new line of hermetically sealed, transistorized servo amplifiers.

The new units covered by Bulletin 101 are designed specifically for applications requiring a high order of precision, miniaturization, and dependability. These amplifiers produce voltage gains of 100 to 1, 200 to 1, 2000 to 1, and 4000 to 1. They are designed to be used with the company's motors and motor-driven induction generators in sizes 8, 9, 11, 15, and 18.

Data includes dimension drawings,

(*Continued on page* 192)

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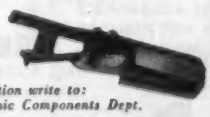

For further information write to:
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GENERAL ELECTRIC

Regulated Transistor Supply

wiring and socket base diagrams, electrical characteristics, and other important information.

"CERAMAGNET" DATA

Stackpole Carbon Company, St. Marys, Pa. has available a 12-page bulletin covering its "Ceramagnets"—high coercive force permanent magnets that are molded from low cost ceramic powders.

Bulletin RC-11A includes many helpful diagrams and illustrations of specific uses for the product along with advantages for various mechanical, electrical, and electronic applications. Also included are ten graphs plotting every magnetic characteristic of importance to design engineers.

RECTIFIER REPLACEMENT DATA

The Semiconductor Products Department of *General Electric Company,* Syracuse, N. Y. has issued a new, revised replacement guide for electronic service technicians on using germanium rectifiers to replace selenium rectifiers in television sets.

The guide lists all American-made television sets built since 1953 in which selenium rectifiers may be conveniently replaced by the company's germanium units. The guide lists the manufacturer's name, model number, and chassis number, the selenium rectifier part number, and the snap-in replacement rectifier number. In addition, wiring and mounting instructions for germanium rectifiers are included.

The company's authorized tube and transistor distributors will supply this guide without charge on request or technicians can write the firm direct.

"SUCCESSFUL FINANCIAL MANAGEMENT"

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y. has prepared and is distributing a new booklet, "Successful Financial Management," which suggests methods for distributors of electronic parts, such as receiving tubes, TV picture tubes, antennas and accessories, to insure adequate financial control over funds invested in their businesses.

Prepared by Gordon K. Douglass of the company's special finance services, the book outlines specific steps which can be taken to avoid financial pitfalls. The company is distributing this booklet without charge as a service to the electronic distributing field.

TV ACCESSORIES

A 32-page publication providing complete information on a wide variety of products used in TV installations has just been issued by *iE Manufacturing,* 325 N. Hoyne Ave., Chicago 12, Ill.

This multi-color catalogue covers the firm's complete line of television hardware accessories, guy wire, telescoping masts, and masting. A complete line of accessories is covered in the text and there are illustrations and descriptions of each item.

Copies of this new publication are available without charge upon direct request to the manufacturer.

MARINE RADIO EQUIPMENT

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y., has issued a four-page data sheet covering an extensive line of marine radio equipment for the small boat owner.

Pictured and described in some detail are portable marine radiotelephones; direction finders and depth indicators; fixed installation radio telephones; portable power sources, both regular and sine-wave regulated; inverters and converters; portable receivers; and radio transceivers.

The data sheet is available without charge on request. Please specify ST-69 when writing.

ALUMINUM ELECTROLYTICS

General Electric Company has recently issued a four-page data sheet which describes its line of d.c. aluminum electrolytics for radio, television, and other communciations equipment applications.

Entitled *"Alumalytic* Capacitors," the publication lists performance characteristics and includes tables which enable the reader to calculate the capacitor's size from voltage and microfarad ratings.

The folder may be obtained by writing the company's Irmo, South Carolina plant and asking for publication GEZ-1912. —30—

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1C5GT	.40	5U4G	.48	6BQ6GT	.79	7A7	.44	12SQ7	.54
1C6	.25	5U8	.79	6BQ7	.77	7A8	.44	12SR7	.44
1C7G	.25	5V4G	.57	6BY5G	.57	7AU7	.69	12SK7	.47
1D5GP	.42	5V6GT	.49	6BZ7	.75	7B4	.43	12SL7GT	.59
1M4G	.45	5X8	.79	6C4	.36	7B5	.40	12SN7GT	.56
1J6GT	.46	5Y3	.38	6CB6	.50	7B6	.41	12SQ7	.39
1L4	.45	5Y4G	.42	6CD6G	1.17	7B7	.42	12V6GT	.44
1L6	.54	6Z3	.44	6CU6	.79	7B8	.46	12W6	.59
1LA4	.55	6A7	.59	6D6	.67	7C4	.40	12X4	.36
1LA6	.46	6A8	.46	6E5	.43	7C5	.41	14A7	.44
1LB4	.58	6AB4	.44	6F5	.36	7C6	.42	14B8	.44
1LC5	.48	6AC7	.69	6F6	.37	7C7	.44	14Q7	.44
1LC6	.46	6AF4	.75	6H6	.37	7E5	.44	19T8	.69
1LD5	.56	6AG5	.49	6J4	1.59	7E6	.44	19BG6G	1.17
1LE3	.56	6AG7	.68	6J5	.38	7F7	.48	25BQ6GT	.84
1LH4	.63	6AH6G	.89	6J6	.48	7F8	.58	25C5G	.79
1LN5	.46	6AH8	.70	6K6GT	.38	7H7	.85	25C6G	1.29
1N5GT	.49	6AK5	.53	6K7	.38	7Q7	.74	25CU6	.99
1S5	.50	6AL5	.41	6L6	.67	7W7	.57	25L6GT	.46
1S5	.45	6AM8	.78	6N7	.59	7X7	.84	25W4GT	.42
1T4	.50	6AN8	.78	6Q7	.39	7Y4	.54	25Z6	.38
1U4	.46	6AQ5	.44	6S4	.39	7Z4	.39	27	.24
1U5	.45	6AS5	.47	6S8GT	.70	12A4	.59	35B5	.47
1V2	.70	6AS7G	2.28	6SA7	.47	12A5	.40	35C5	.47
1X2	.66	6AT6	.75	6SC7	.47	12A8	.59	35L6GT	.46
2A3	.49	6AT8	.79	6SC7	.47	12AB5	.59	35W4	.38
2A7	.54	6AU4GT	.64	6SG7	.40	12AD5	.49	35Y4	.38
2D21	.95	6AU5GT	.68	6SH7	.42	12AE6	.60	35Z3	.40
3A4	.50	6AU6	.42	6SJ7	.42	12AT6	.46	35Z5GT	.38
3A5	.50	6AU8	.79	6SK7	.49	12AT7	.58	39/44	.25
3AL5	.52	6AV5GT	.64	6SL7GT	.58	12AU6	.42	50A5	.47
3AU6	.53	6AV6	.38	6SN7GT	.56	12AU7	.58	50B5	.47
3BZ6	.57	6AW8	.89	6SQ7	.40	12AV6	.41	50C5	.47
3BC5	.57	6AX4GT	.68	6SS7	.40	12AV7	.66	50L6GT	.44
3BN6	.57	6AX5GT	.58	6T4	.55	12AX4GT	.64	80	.39
3C86	.57	6BA6	.46	6T8	.67	12AX7	.62	84/6Z4	.45
3Q4	.55	6BC5	.49	6U5	.54	12AZ7	.62	117L7GT	1.25
3Q5GT	.56	6BC8	.69	6U8	.79	12BA6	.45	117N7GT	1.25
3S4	.46	6BD5GT	.52	6V3	.79	12BA7	.59	117P7GT	1.25
3V4	.55	6BE6	.45	6V6GT	.45	12BE6	.45	117Z3	.38
4BQ7	.75	6BF5	.59	6W4GT	.38	12BH7	.59	117Z6GT	.61
4BZ7	.75	6BG6G	1.17	6W6GT	.52	12BY7	.63		
5AM8	.79	6BH6	.50	6X4	.38	12CA5	.59		
5AN8	.79	6BJ6	.46	6X5	.38	12CU6	.79		
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hours a day for a year before the bat-

battery from the power transistor

Regulated Transistor Supply

(*Continued from page 55*)

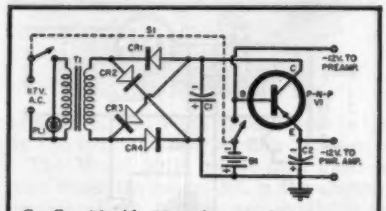
This means that even though the supply voltage contains considerable a.c. ripple, the output voltage will be virtually hum free. A practical emitter follower regulator circuit is shown in Fig. 2.

T_1 is a 25.2 v. filament transformer used to step down the line voltage and provide isolation from the power lines. The secondary of the transformer is connected to a bridge rectifier that gives the advantages of a full-wave rectifier without the necessity of a center-tapped transformer. The *General Electric* germanium rectifiers used, although little larger than a pencil eraser, are rated for 25 amperes peak, 150 ma. average current at 131°F so there is plenty of built-in safety factor for this application. The only filtering used is a single 50 μfd. capacitor, but as mentioned previously there is no need for extensive filtering of the d.c. supply to the emitter-follower regulator. The a.c. output voltage of the rectifier and filter is about 35 volts.

The voltage reference used in this power supply is three, 4-volt mercury cells connected in series. It may not seem very elegant to use batteries in a power supply designed to eliminate the need for batteries, but there are several advantages to the use of batteries as a reference. The first advantage of batteries is that they are cheap and readily available. It is possible to use a zener diode as a reference, but to achieve good results it is necessary to use an additional transistor and zener diode in the circuit to act as a constant current source for the reference diode, all of which adds to the expense.[2]

By using batteries for a voltage reference, it is also possible to operate the magnetic cartridge preamplifier from the same batteries and eliminate the possibility of any hum being introduced into the first stages where signal levels are low. The batteries used have a capacity of 2200 ma.-hours and since the current drain is low, the power supply could be operated three

Fig. 2. Complete transistor regulated supply.



C_1, C_2—50 μfd., 50 v. elec. capacitor
S_1—D.p.s.t. switch
T_1—Fil. trans., 117 v. a.c. to 25.2 v. @ 1 amp. (Stancor P-6469 or equiv.)
B_1—Three 4-volt mercury cells in series (Mallory TR-233R or equiv.)
PL_1—117 volt neon bulb
CR_1, CR_2, CR_3, CR_4—Germanium rectifier (General Electric 1N91)
V_1—Power transistor (Mount on heat sink, see text. P-11, 2N256, 2N156, or equiv.)

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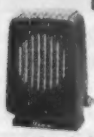

C - 700
Table crystal microphone designed for tape recorder. Especially designed for speech, but usable for various purposes due to good characteristics. Frequency range: 70 - 7,000 c/s ± 7 db. Sensitivity - 52 db. Die-cast body finished in Dark Brown.
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C-100 CRYSTAL MIKE
Rod type small and light crystal microphone; easily removed from stand and used as a hanger mike by means of an adapter. Frequency range: 150 - 8,000 c/s ± 7 db. Sensitivity — 55 db. Chromium plated body with built-in ON-OFF switch.
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PT — 1B. Cone type. Frequency range — 3,000 to 16,000. Maximum power (W) — 20. A Crossover network is required. See LC — 100. Voice coil impedence, 8 - 16 ohms.
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hours a day for a year before the batteries would need to be replaced.

Construction

The only critical part about the construction of this regulated power supply is the necessity for mounting the power transistor on a heat sink. It is also necessary to insulate the transistor from the heat sink because the collector is connected to the transistor case and if the transistor is not insulated, the chassis will be "hot". The author used a *Minneapolis-Honeywell* P-11 transistor which is furnished with a mica insulating washer. This transistor and washer were bolted on a 2" x 2" metal plate and the plate, in turn, was bolted to a metal box 3" x 4" x 5". The bridge rectifier and capacitors can be mounted on terminal boards and the batteries held by conventional battery clips. The bottom view of the assembly is shown in the photograph.

It is necessary to disconnect the battery from the power transistor when the power supply is not energized otherwise the battery would quickly discharge through the base-emitter circuit. For this reason, the a.c. "on-off" switch also disconnects the battery.

If it is desired, the power supply circuit could be built on the same chassis as a transistor amplifier. The author chose to make it a separate unit to minimize hum problems and to make use of the power supply for experimentation with other circuits. By changing the batteries, it is possible to get a variety of regulated output voltages. A more elaborate version of this power supply might also be built with a multi-position switch to select the desired output voltage.

REFERENCES

1. Lowry, Hugh, R.: "All Transistor Hi-Fi Amplifier," RADIO & TELEVISION NEWS, *November 1956.*
2. Lowry, Hugh, R.: "Transistorized Regulated Power Supplies," Electronic Design, February, March 1956.

—30—

Power Supply for Transistors

By PAUL S. LEDERER

EXPERIMENTATION with transistors requires a low-voltage d.c. supply. Batteries are generally used if one or two d.c. voltages are all that are required. If the range of experimentation is to be extended, however, the number of batteries required would become cumbersome.

The variable voltage power supply to be described will deliver a maximum current of 22 ma. (at 15.5 volts) into a 700-ohm load. The maximum voltage obtainable is about 60 volts, while the minimum is about 10 volts. This range will satisfy most transistor requirements other than those of power transistors. The ripple reaches a maximum of about 20 mv. r.m.s. when the supply delivers the minimum voltage (4.2 volts) into a 700-ohm load. This percentage ripple of .5% decreases when the supply output voltage is raised.

The power supply uses a small power transformer (designed to power preamplifiers and other similar small devices) delivering about 115 volts at 30 ma. and 6.3 volts at .55 amp. This transformer, or one of similar characteristics, is available at most radio supply stores. A small selenium half-wave rectifier in series with a current limiting resistor charges an electrolytic capacitor connected to the plate of a triode. This triode, a type 6C4, is in series with the load on the supply output. Its action as a variable attenuator depends on control of the tube's plate resistance by means of the grid bias. This bias is controlled by a pot connected across a small neon bulb.

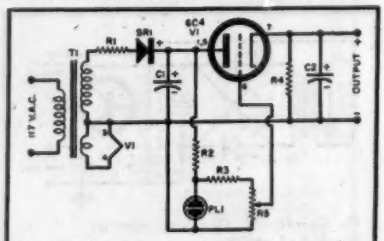
The neon bulb, fed from the rectifier through a series resistor, acts as a voltage regulator. The plate resistance of the tube is determined by the grid-to-cathode voltage at the tube, which is the difference between the voltage from the cathode to the minus side of the supply (the voltage across the external load) and the voltage from the triode grid to the minus side of the supply. This latter voltage depends on the pot setting and determines the output.

A certain amount of regulation is inherent in this supply. For a given setting of the pot, if a change of load occurs, such as an increase in the current drawn from the supply, the following will happen: The increased current will cause a larger voltage drop across the tube, resulting in a lower voltage from the cathode to the minus side of the supply (and thus the output). This results in a lowered grid-to-cathode bias with a resulting decrease in plate resistance of the tube. This, in turn, lowers the voltage drop across the tube and raises the voltage across the load.

Both sides of the supply are brought out to insulated terminals. This makes it possible to ground either the positive or negative side of the supply making it suitable for "p-n-p" or "n-p-n" transistors.

The entire supply occupies a space of about 4" x 4" x 3". —30—

A variable voltage power supply circuit for use in experimental transistor work.



R_1—47 ohm, 1 w. res.
R_2—18,000 ohm, 1/2 w. res.
R_3—33,000 ohm, 1/2 w. res.
R_4—120,000 ohm, 1/2 w. res.
R_5—100,000 ohm linear taper pot
C_1, C_2—50/30 μfd., 150 v. elec. capacitor
T_1—115 v. @ 30 ma., 6.3 v. @ .55 a. 130 v. r.m.s. input
SR_1—25 ma. (or larger) selenium rectifier,
PL_1—NE-2 neon bulb
V_1—6C4 tube

ber of applications. It can be used for

What's New in Radio

CRT ADAPTER

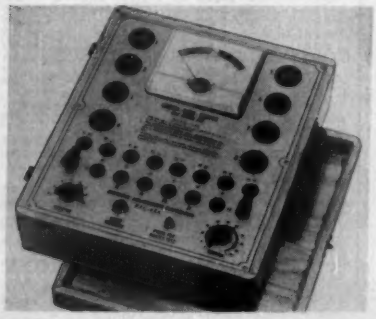
B&K Manufacturing Co., 3731 N. Southport Ave., Chicago 13, Ill. is now offering a new, low-cost CRT adapter for testing and rejuvenating color TV and 110 degree picture tubes.

The Model C40 adapter is designed to be used with the company's Models 400 and 350 CRT instruments. It tests each gun of the color picture tube separately for continuity, inter-element shorts, opens, or leakage. It checks each gun for emission and cut-off voltage. By comparing the emission readings of red, green, and blue guns, difficult color troubles can be isolated and detected. If the emission of one color gun is low, that gun can be rejuvenated. Life or "slump" tests indicate variations between color guns which will cause difficulties in color response.

A bulletin providing complete information on this adapter is available from the manufacturer on request. Specify Bulletin No. C40.

"SPEEDI" TUBE TESTER

Electronic Measurements Corp., 625 Broadway, New York 12, N. Y. is now offering its "Speedi" tube tester in two models and two versions.



The instrument is simple to operate, requiring only two settings. It checks for shorts and leakages as well as quality. It will handle over 375 of the currently listed tubes including the 0Z4. It will check octals, loctals, miniature, and 9-pin tubes. New listings will be supplied by the manufacturer as new tubes appear on the market.

The Model 301P comes in a hand-rubbed oak carrying case while the Model 301 is the sloping-front, counter-case version. Both models are available in kit form as well as factory assembled.

INSULATING VARNISH

General Cement Mfg. Co., 400 S. Wyman St., Rockford, Ill. has introduced a new coating that provides protective insulation for electronic equipment circuitry.

Known as the *"G-C* Red Insulating Varnish," the product is said to have high arc resistance values for a num-

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12 Volts 10½ Amps Input. 625 V. 225 Ma. Output. NEW..... $16.75 ea.

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Pri. 103/115/125V.—Sec 115V. 1500 Watts Dual AC receptacle. Stancor #P6123. $24.50 ea.

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Primary 115 V. 60 Cy. Sec. 24 Volts @ 3 Amps. Full case. BRAND NEW.. $2.49

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6.3V 10 Amp 115V-60cy Primary— Each $2.19

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115 V 60 Cyc Coil DPDT, 10 Amp Contact....ea. $2.49

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(Ideal for Model Controls, Etc.)
Contains a sigma midget 5,000 ohm, relay (trips at less than 2 MA), high impedance choke, bi-metal strip, neon pilot and many useful parts. The sensitive relay alone is worth much more than the total low price of..... $1.10 Each 10 for $9.25

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Primary 115V, 60 Cy. Sec. 425-0-425V. @ 200 Ma., 6.3V @ 5 Amp., 5V @ 4 Amp. Std. Mounting, plus 6 Hy, 200 Ma. choke and Two 8 Mfd. Oil Condensers..... $7.25 ea.

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0-1 Amp	$2.95	0-5 Ma	$3.95
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0-120 Ma RF with external Thermocouple	3.95	0-150 VDC	3.95
0-150 V. AC	3.95	200-0-200 V. DC	3.95
0-300 VAC	3.95	0-2 Amps DC	3.95
		0-1.5 Amps DC	2.95
		0-4 Amps Dc	3.95
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1 mfd 600 VDC	$ .25	4 mfd 1000 vdc.	1.25
2 mfd 600 VDC	.45	4 mfd 1500 vdc.	1.75
4 mfd 600 vdc.	.75	2 mfd 2000 vdc.	1.50
8 mfd 600 vdc.	.95	3 mfd 2000 vdc.	2.75
10 mfd 600 vdc.	1.10	4 mfd 2000 vdc.	2.95
20 mfd 650 vdc.	3.25	1 mfd 3000 vdc.	1.85
1 mfd 1000 vdc.	.60	1 mfd 5000 vdc.	3.25
2 mfd 1000 vdc.	.75		

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ber of applications. It can be used for all solder connections, high voltage points, and anti-corona protection, with special emphasis on government-specification electronics gear. It has good adhesive qualities and is resistant to heat, oil, and acids. It is being made available in 2, 4, and 8 ounce bottles, 1 and 5 gallon cans, and in 55 gallon drums.

CLUTCH-FACING KIT

Colman Tool & Machine Co. of Amarillo, Tex. is now marketing a replacement clutch-facing kit to aid in correction of a slipping manual-tuner on push-button-tuned auto radios.

The plastic-boxed kit contains clean-

ing swabs and two solvents for clearing old cements off metal clutch plates and 25 assorted die-cut clutch facings to fit *Delco, Ford, Mercury,* and *Lincoln* auto radios. The clutch facings are self-sticking, adhesive-backed cork and rubber composition which the manufacturer claims will last longer than the original facings.

COLOR GUN KILLER

Perma-Power Company, 3100 Elston Ave., Chicago 18, Ill. has released a "Color Gun Killer," the newest unit in its line of equipment for the technician.

The Model T-101 enables each gun of a three-gun color tube to be oper-

ated singly or in combination. It avoids cutting or disconnecting leads to make color purity adjustments.

Special illustrated literature on this unit is available on request.

TUBE-TRANSISTOR TESTER

B&K Manufacturing Co., 3731 N. Southport Ave., Chicago 13, Ill. has announced the availability of a new portable dynamic mutual conductance tube and transistor tester, the Model 650 "Dyna-Quik."

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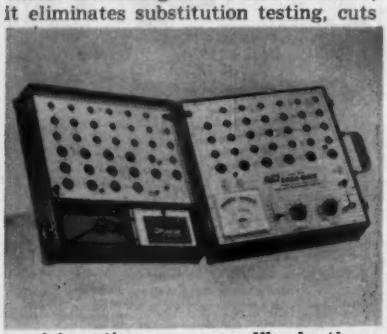

servicing time, saves callback time, and results in additional profits from tube sales.

The Model 650 will check over 500 tube types. Over 125 tube types, with settings, are listed on socket panels for maximum operating speed. Complete tube socket and setting reference are included in a fast telephone-index type selector. Sixteen spare sockets and extra filament voltages have been included to eliminate early obsolescence.

The tester comes in a sturdy, luggage style carrying case which measures 15¾"x15"x6½". Bulletin No. 650, available from the company, provides complete specifications on this tester.

HIGH-PERVEANCE TUBE

The Electron Tube Division of *Radio Corporation of America*, Harrison, N. J. has developed a new high-perveance beam power tube of the glass-octal type, designed especially for use as a horizontal-deflection amplifier tube in color TV receivers.

The 6DQ5 has a maximum plate dissipation of 24 watts and a maximum grid-No. 2 input of 3.2 watts. These ratings, in addition to a peak positive-pulse plate voltage rating of 7000 volts (max.) and a peak cathode current rating of 1000 ma., enables a single 6DQ5 to provide full deflection for the *RCA* 21" color picture tube.

CABLE IN TAPE FORM

Tape Cable Corporation, 790 Linden Ave., Rochester 10, N. Y. has developed a flat, multi-conductor electrical cable, known as "Tape Cable."

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456	560 VCT @ 300 MA	5.0V @ 5A	6.8V @ 10.1A	$3.25
457	620 VCT @ 110 MA	5.0V @ 2A	6.4V @ 3A	$1.25
458	560 VCT @ 300 MA	5.0V @ 5A	6.8V @ 6A	$2.95
451	700 VCT/412 VCT @ 175/100 MA	5.0V @ 3A	5V @ 2A	$2.95
442	512 VCT 54 MA		6.4V @ 2.4A	$1.25
488	440 VCT 50 MA		6.4V @ 2.5A	$1.25
443	520 VCT @ 52 MA		6.4V @ 2.3A	$1.25
490	156 VCT @ 125 MA	6.4V @ 5.1A	6.4V @ 6A	$1.50

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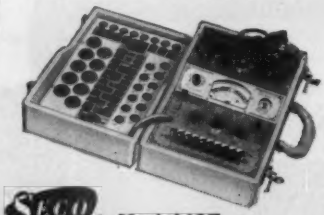

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The DEEP-ETCHED copper circuit board replaces all wiring and guarantees that every PERI-50 AMPLIFIER built will perform exactly like the laboratory original—whether built by amateur, audiophile or electronic engineer!

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tion. Thus the cable has minimum cross-sectional area, minimum interconductor capacitance, high tear strength, high flex life, and high resistance to chemical attack, according to the maker.

Conductors in the standard cable have .100 inch center-to-center spacing in accordance with the recommended RETMA grid pattern for printed wiring. Nine standard sizes have been established with 9, 14, 17, 21, 27, 30, 36, 40, or 50 conductors.

Complete technical information on this new product will be supplied by the manufacturer on request.

MICROMINIATURE DISC UNITS

Centralab, a division of *Globe-Union, Inc.*, 900 E. Keefe Ave., Milwaukee 1, Wis. has introduced a new microminiature disc capacitor which has

been designed to meet the small size, high capacitance demands of transistor circuitry needed in bypass and coupling applications.

Tradenamed "Ultra-Kap," the new unit is intended to meet the stringent demands of space, performance, and economy. Its extremely low power factors are said to enable it to outperform electrolytics of similar capacitance values.

The company will supply further details on these "Ultra-Kaps" on request.

D.C. SUPPLY

Electro Products Laboratories, 4500 N. Ravenswood Ave., Chicago 40, Ill. has developed a new dual-range d.c. supply which is designed especially for transistor circuitry.

With less than 10 millivolts ripple

at top load, the Model "EFB" is designed for operating and testing transistor circuits and electronic equipment requiring a d.c. power supply. The unit supplies a continuously variable power source from 0 to 16 volts for current loads to 8 amperes

INFRARED SNOOPERSCOPES!
Infrared viewers for seeing in total darkness. Now available for civilian use!

Army Model M-2
Bell & Howell—uses 1P25-A Image tube. Priced from $50 to $125*

IMAGE TUBE POWER SUPPLY
SNOOPERSCOPE PART #1450-A.
Power-pack for 1P25-1P25-A tubes (will also supply CV-147 tubes). Input 6 volts d.c. at only 0.33 ampere. Output 4.250 volts d.c. and additional focusing voltages. Operates from single 6-volt dry cell lantern battery. Size 4½"x3"x8". Gov't. cost $92.00. NEW CONDITION. Complete, only ..... $7.95 ppd.

INFRARED LIGHT SOURCE
SNOOPERSCOPE PART #1364-A.
Input 6-volts, 5 amperes. 5¾" double glass filter. Projects a powerful beam of invisible radiation (free of all visible light) illuminates for infra-red viewing or photography up to distance of 400 feet. STK. #L-5459. Cash with order—merchandise guaranteed. BRAND NEW, only ..... $6.95 ppd.

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RCA LICENSED
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For Radio Alone
Complete SALE PRICE
$59.95
1958 Model
Ready to Play
Here is a complete Hi-Fidelity FM-AM radio made by one of the top manufacturers. This set is ideal for custom installations. Built-in 14-Watt Hi-Fidelity push-pull amplifier. Separate bass and treble controls. built-in AM and FM antennas, phono jack, output jack for tape recorder. Frequency Range 20-20,000 cycles ±2db. Output trans. tapped for 3.2, 8 and 16 ohms. This 11 tube set comes complete with crystal and magnetic phono inputs, including a 12" RCA extended range speaker. Size 12½x7½x7½". Amplifier, Pre-amplifier, AM-FM tuner—ALL ON ONE CHASSIS. Schematic Diagram on Request.
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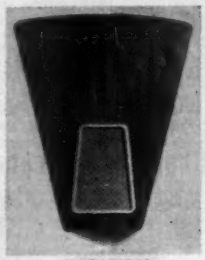
Compare Our Specifications With Other Tuners Costing Up To Twice Our Price. Reception to 150 Miles. Factory Wired and Tested.

Sensitivity: 0.9 microvolt for 20 db quieting: 1.8 μv for 30 db. Frequency response 20-20,000 cps ± ½ db. Inputs: 300 OHM balanced. IF band width 200 KC. Stability: only 20 KC. Stable after 1 minute. 6 Mullard high gain, low noise tubes; 10 tuned circuits. Front end completely shielded in a solid casting. Better than FCC requirements. Frequency range: 88 to 108 MC with 0-100 logging scale. Grounded grid RF amplifier & reflex converter completely sealed—eliminates microphonics. Output level control: styroflex & ceramic condensers used throughout with carbon deposited resistors. "V" beam tuning indicator. Illuminated, unbreakable precision-calibrated dial assembly. Phono input connection: set is off when phono is on. 1 year warranty on all part defects. Tubes carry standard 90 day. 110/125V AC; 50-60 cycles; 30 watts. 10½" wide; 5¾" high; 6½" deep. 12 lbs.

AIREX'S LOW INTRODUCTORY PRICE **$44.95**

Wood cabinet (Mahogany or Blonde) **$8.95**

TSL Concert Soundcorner



CARLTON

WALDORF

Now you can add a true Hi-Fidelity 2-way speaker system to your present amplifier at new low cost without sacrificing floor space. These units are ideal for use in Stereo systems where 2 separate speakers are desired on the same wall. Excellent for extending your present loudspeaker system, or can be used to replace your present speaker in your radio or phonograph. Hangs on the corner of the wall and uses the sides of the wall as part of the enclosure. Uses Lorenz LP215 bass speaker, Lorenz LPH65 tweeter unit and associated crossover network. Units are mounted on a beautifully finished multiple ply bonded hardwood in mirror polished walnut. Carlton model has gold frame with neutral color grill cloth to blend in with any wall color and is washable. Every unit is fully guaranteed to give you the finest in listening pleasure. Specifications: Size: 27" high, 24" wide at top and 11½" at the bottom. Frequency range 35 to above 17,000 cps. Power rating 15 watts, Impedance 8 ohms. No intermodulation distortion. Comes complete ready to use. A product of British craftsmanship.

AIREX'S LOW INTRODUCTORY PRICE **$44.50** either model

If you are building a Hi-Fi System, SEND US YOUR LIST OF COMPONENTS. We will give you a PACKAGE QUOTATION ON THEM.

All merchandise is brand new, factory fresh & guaranteed. Mail & phone orders filled on receipt of certified Check or MO of 20% of items as a deposit. Balance C.O.D., F.O.B. N. Y. Prices & specifications subject to change without notice.

AIREX RADIO CORP.
64-R Cortlandt St., N. Y. 7, CO 7-2137

and 0 to 32 volts for current loads to 4 amperes. Accurate current and voltages are indicated on d'Arsonval type meters.

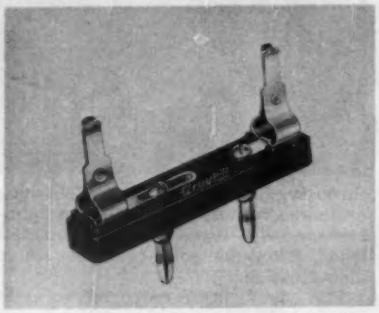
The circuit is built into a 12"x7"x 8½" hammerloid steel cabinet. The instrument is designed for continuous medium-duty operation.

Write R. C. Crossley, sales manager of the firm, for more detailed information.

TEST CLIP ADAPTER

Grayhill, Inc., 561 Hillgrove Ave., La Grange, Ill. is now marketing a universal test clip adapter designed to fit all banana-type jacks.

Known as the "2-7 Test Clip



Adapter," it features spring-tension test clips on top for simplified testing of resistors, capacitors, germanium diodes, and similar lead-wire-type components. Adjustable banana jacks underneath may be adjusted to satisfy any banana plug spacing from standard ¾" centers to 1¼" centers. Nickel plated spring clips insure positive contact. The base is of electrical-grade molded plastic.

Complete information is available from the manufacturer on request.

TRANSISTOR POWER SUPPLY

Perma-Power, 3100 N. Elston, Chicago 18, Ill. is now offering a transistor power supply, Model A-400, which has been especially designed for servicing and testing transistor portable radios, amplifiers, phonographs, and similar equipment.

The power supply has low ripple

and constant internal impedance comparable to that of a battery. This unit eliminates battery stocking and the need for additional low current metering necessary for quick diagnoses.

Ranges of 0-15 ma. and 0-60 ma. and 0-15 v. and 0-30 v. cover both all-transistor and hybrid equipment with 2% accuracy. Housed in a slope front

MICROAMPERE METER

3" 0-50 Microamps. Scale 0-100 (50 Microamp scale supplied) **SPECIAL** **$6.95**

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HIGH VOLTAGE INSULATION

Primary 220 V. AC Secondary 5V 10 amps with 35 KV insul. each $14.95
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PLATE TRANSFORMER

Primary 110 V.-60 cy. or 220 V. 1½ KW. Secondary 2350-0-2350 V. AC @ 660 mils full wave by using two transformers. Each—Size: 7"x7"x7". Weight 40 lbs. each with Porcelain Insulator ..... 2 FOR **$24.95**
1 of above 2350 V. AC @ 340 MA ½ wave. Each $14.95

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16,000 ohm in dual 8,000 ohm coils. (Can be paralleled) SPDT adjustable silver contacts. Adjustable armature tension. Operates on 500 microamperes or less. Ultimate in a sensitive relay. Ideal for precision control work ..... ea. **$3.95**
Write for quantity prices.

REDMOND BLOWER

110V, 60 cyc. .3 Amp. 1600 Rpm. 3¾" Blower Wheel—Outlet 2" Diameter. Suitable for cooling Transm. tubes, etc. ..... ea. **$7.95**
2 for $15.00

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(Ideal for Model Controls, Etc.)

Contains a sigma midget 8,000 ohm, relay (trips at less than 2 MA), high impedance choke, bimetal strip, neon pilot and many useful parts. The sensitive relay alone is worth much more than the total low price of... **$1.10** ea. 10 for **$9.25**

RELAYS

Sealed Claire SPST. Norm. closed 3000 ohm coil 4 ma. ..... ea. **95c**
Claire Telephone Type 11,300 ohm coil DPDT cont. 10 amp 125V. Sens. 4MA. ea. **$3.95**
Cutler Hammer Contactor—110V 60 cy. 4 pole a.t. Norm. open 25 amp contacts .ea. **$6.95**
Hermetically Sealed Relay Coil 110V AC 60 cy SPDT Contacts 5 Amps..... ea. **$1.85**
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G.E. Plug in Relay 5 prong 2000 ohm coil 4 mil. SPDT (Sigma 4F)..... ea. **$2.50**
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6 MFD	600 VDC	.85	4 MFD	3000 VDC	6.95
8 MFD	600 VDC	.95	1 MFD	7500 VDC	6.95
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1 MFD	1200 VDC	.45			
.5 MFD	1500 VDC	.75			
2 MFD	1500 VDC	1.10			
6 MFD	1500 VDC	1.95			
10 MFD	1500 VDC	3.50			
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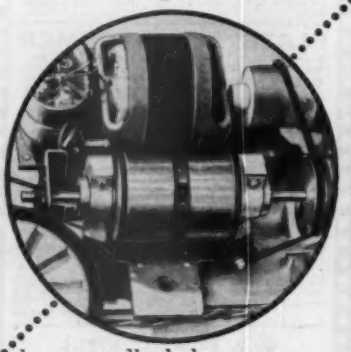

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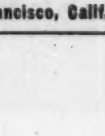

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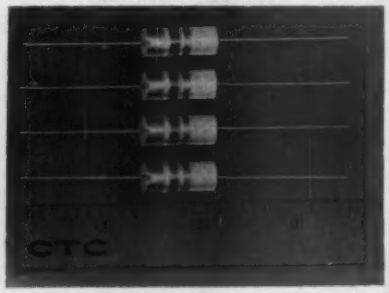
1564 Market Street, San Francisco, Calif.

hammerloid cabinet, this unit has been designed throughout with the technician in mind. A technical catalogue sheet giving full details is available on request.

ENCAPSULATED CHOKES

Cambridge Thermionic Corporation of Cambridge, Mass. is now offering a family of epoxy encapsulated chokes from stock. There are 13 chokes in the group, ranging in values from 1.1



through 120 microhenrys, following preferred values. All are 5/16" in diameter and ¾" long, with axial pigtail leads. They are color-coded for value identification.

The chokes are constructed so as to have maximum ruggedness and resistance to moisture, temperature, and all environmental extremes. Write the manufacturer for more complete details.

R.F. SIGNAL GENERATOR

The Components Division of *Radio Corporation of America,* Camden, N. J. is now offering a new r.f. signal generator, the Model WR-49B.

This instrument is a portable, all-purpose radio and TV service signal generator for uses requiring a modulated or unmodulated r.f. sine-wave signal between 85 kc. and 30 mc. It provides accurately calibrated signals in six bands with or without audio modulation and a built-in attenuation range of 65 db.

Functionally designed for rapid and accurate dial readings, the WR-49B features burnout protection in both equipment and signal generator, plus full-length shielding of output cables for minimized radiation and hum pickup. —30—

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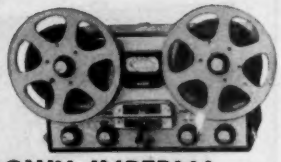

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Q-METER, Boonton 160-A with fourteen 103-A Inductors, LC Dial, Series Jig for impedance measurement, instructions, Spare set tubes and Thermocouple. A-1 Condition. $450.00. J. E. Payne, 15 Spring Drive, Florissant, Missouri.

FOR Sale—4 Ampex 8-hour Tape Reproducers, Model 450. These list at $600 and will be sold for $250 each, F.O.B. Boston. Contact Mr. Paul Cifrino, Supreme Markets, Inc., 540 Gallivan Boulevard, Dorchester, Massachusetts.

CATHODE Ray Beamer Kinescope Analyzer Triplett Electric Instrument Model CB 54A Raytronic Lab. Like new. Make offer. Graybar Electric Company, 327 North West Street, Syracuse, New York.

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200 UNMARKED Ceramicons—Mixed Values. $1.00. D. Schneider, 3763 New York Ave., Seaford, N. Y.

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TUBES—TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed, 1st Quality, Top Name Brands Only. Write For Free Catalog or Call Walker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.

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FREQUENCY Modulation Tuners, 88-108 Megacycle, Complete with 4 tubes, $12.95. Grutman, One East 167th Street, Bronx, New York.

COMPLETE Television Sets $11.95. Jones TV, 1115 Rambler, Pottstown, Pa.

TUBES—Television, Radio, New, Guaranteed, Boxed, Approximately 80% off, Transmitting, Special Purpose Tubes, write Bell Electronics, 40 Canal, New York City 2.

MONITORADIO, Police-Alarm Receivers, new, used. Ladd Electronics, 111 North 41st, Omaha, Nebraska.

FREE, Cathode Ray Tube with 100 pounds surplus electronic parts and equipment $9.95. AC cords with plugs 6 for $1.00. Jumbo 4-pin transmitting tube sockets 4 for $1.00. No C.O.D.s. Alpine Products, Dept. 10C, 2236 Hepburn, Dayton 6, Ohio.

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CYLINDER and old disc phonographs. Edison, Conqueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and coin-operated cylinder phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Box 50 % RADIO & TV NEWS.

WANTED: Receiver R5/ARN-7, MN-62A Transceivers, RT18/ARC-1, AN/ARC-3, BC-788C, I-152C, Collins, Bendix equipment, Test Sets, Dynamotors, Inverters. We pay highest prices. Advise quantity, condition, price first letter. Aircraft Radio Industries, Inc., 15 East 40th St., New York City, telephone LExington 2-6254.

ART—13/T47A Transmitters, $175.00; ART—13/T47 Transmitters, $125.00; BC-788 C Altimeters, $175.00; ARC-3 Transceiver Complete, $325.00; R5/ARN-7 Radio Compass, $175.00; BC-348 Rec'r Modified, $25.00; BC-348 Rec'r Unmodified, $50.00; ARC-1 Transceiver, $300.00; BC-342 Rec'r, $50.00; BC-312 Rec'r, $40.00; I-152-C Indicator, $50.00. Ship Via Express, C.O.D. Subject To Inspection To H. Finnegan, 49 Washington Ave., Little Ferry, N. J.

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0D3	.80	6BN6	1.08	12AU7	.69	7193	20/$1
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1X2A	.68	6J6	.89	12BZ7	.99	4PR60	35.00
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3Q5	.68	6K7	.79	12SA7	.69	4X250	35.00
3S4	.68	6L6	1.19	12SG7	.59	4X500	43.00
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5Y3	.59	6SC7	.89	19BG6	2.15	250T	20.00
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6AC7	.79	6SH7	.69	25BQ6	1.39	410A	14.00
6AG7	.89	6SJ7	.69	25L6	.72	450T	43.00
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6AL5	.59	6SN7	.72	25Z6	.75	809	3.00
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6AS7	3.00	6SR7	.75	EL37	3.49	811	3.00
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6AU5	1.19	6V6	1.39	35Y4	.69	814	3.00
6AU6	.59	6W4	.79	35Z3	.67	815	6.00
6AX4	.79	6W6	.89	50A5	.69	829B	6.00
6BA6	.59	6X4	.39	50B5	.69	832A	6.00
6BA7	1.00	6X5	.49	50C5	.69	866A	1.35
6BE6	.69	6Y6	.89	50L6	.69	5514	2.98
6BE6	.59	7N7	.89	KT66	3.20	5879	1.25
6BG6	1.50	12AL5	.59	75	.89	5881	2.85
6BH6	.79	12AQ5	.75	80	.89	6550	3.90

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TPF57/2500V@10MA/2.5V@2A, $4 @. 3/$10, 5 for $15

TPF58/5850, 5400, 5000VCT@40MA USN.... $6 @

TF01/2.5V@2A $1 @. TF02/2.5VCT@10A/5KV $3 @

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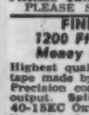

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"TAB"

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OCTOBER 1957

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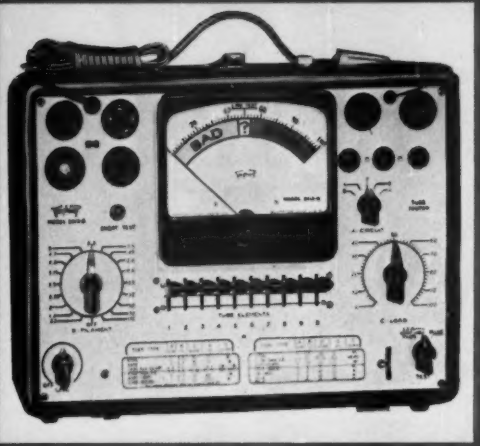

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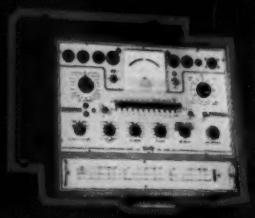

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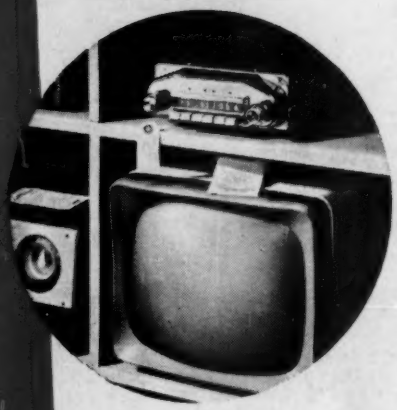

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